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EXCAVATIONS ON RUARANGI PA (SITE N20/41), WHANGAREI, NEW ZEALAND

MOLLY P. HOUGAARD
DENMARK

Abstract. Salvage excavations on Ruarangi Pa in 1965 are described. The pa was occupied several times and the evidence suggested a change in defence from scarps with palisades to artificially heightened scarps. Two kinds of house floor, associated with hearths and pavings of limestone slabs were found, but there were no pits in the excavated area.

An excavation of a small ridge peak pa two miles (3.2 km) south of the city boundary of Whangarei, Northland, was conducted as part of a general investigation of the Ruarangi Maori Burial Ground in 1965. Because the area has been reserved for a long time as a *waahi tapu* (sacred place), it was only at the request of the Maori Land Court and with the consent of the Maori Trustees of the Reserve that these investigations took place. The request was prompted by an application by the Portland Cement Company for quarrying rights to the limestone on the entire forty acre (16.187 hectare) Reserve. The investigations were aimed, therefore at determining and recording the extent of the prehistoric features; and where feasible salvaging some information from any major sites threatened with destruction.

Three investigations were carried out: those on the burials and traditions of the area by R. S. Oppenheim detailed in an accompanying report (this volume); those on the cave systems by L. O. Kermode and members of the Auckland Speleological Society described in the preliminary report presented to the Maori Land Court (Kermode 1965), and those on the ridge peak pa with which this report is concerned, by the author and members of the Whangarei and Auckland Archaeological Societies. The *tapu* on the Reserve was lifted by the Maori Trustees for the duration of the investigation.

The Ruarangi block lies on the foothills of the upper reaches of the Whangarei Harbour and furnished excellent views over the harbour and the surrounding alluvial flats. Kermode (1965) provided a useful description of the local geology:

> The basement rock in this district is greywacke. It forms a series of northward tilted blocks up-faulted on the southern side. Within the fault angle valleys lie young marine sandstones and limestones . . . At the pa site the limestone appears to be overlain by a younger weathered sandstone which probably forms most of the scrub-covered hill just to the north.

The hills of the Reserve are very steep and high. They are partially covered in thick bush, including puriri *(Vitex lucens* Kirk) groves, with the rest in either second growth or rough sheep pasture. Cliffs and large blocks of limestone stand as weathered out-crops in which numerous caves and crevices occur. Some of them have been used as burial places; other overhangs with charcoal, ashes and bits of shell showing on the surface, have at some time served as shelters and

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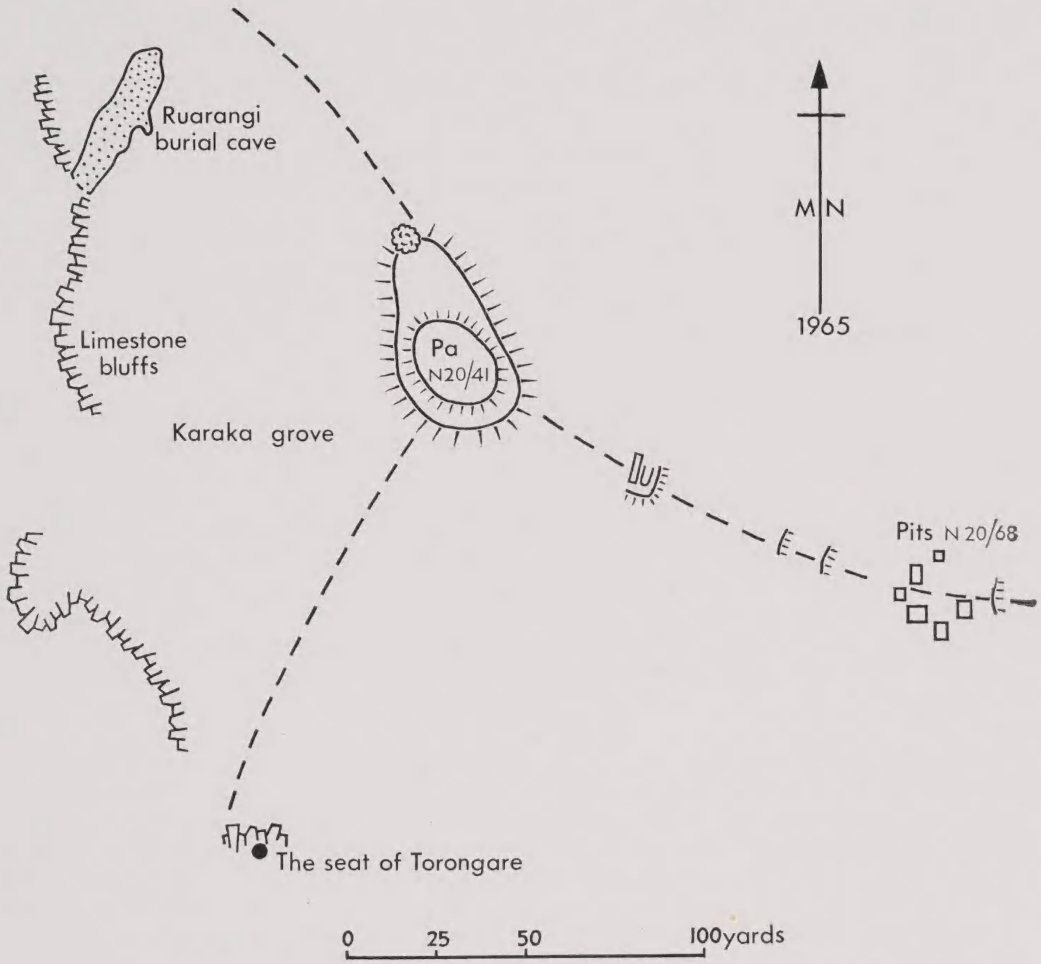


Fig. 1. Ruarangi Pa, N20/41, and adjacent features.

presumably cooking areas. Oppenheim's report describes both the traditional history and the burial system which will not be considered further here. The shelter sites did not seem sufficiently promising to warrant investigation in the time available.

The major feature of archaeological interest is the pa, situated on the peak of a ridge (Fig. 1). It consists of the *tihi,* a small flat area on the highest point; one wide encircling terrace; and several other lower terraces (Fig. 2). All the terraces terminate in high steep scarps and there are no surface indications of ditches, banks or pits directly associated with the pa. While heavy bush surrounds the site, the pa itself is covered mainly with grasses and smaller trees.

Pits, however, do occur outside the natural defences of the pa and sufficiently near it to suggest that they are in some way related (Fig. 1). They were investigated by S. Bartlett, who has provided the following description (pers. comm.):

On the shoulder of the clay ridge sloping down to the west of the pa are seven rectangular pits. The main group of six lies approximately 100 yards below the lowest eastern terrace of the pa, amid second growth, bush and scrub. The sizes vary from 6 x 4 ft to 12 x 6 ft. Of these, five lie with their longer axis across the slopes. Three pits show remains of raised banks up to two feet high on the lower side. Evidently some of the pits were drained, for in midwinter only two were holding water. An exploratory trench (using a spade) showed that the pits were originally about two and a half feet deep. No shells, *haangi* stones or midden refuse was visible in the pit area. Close below this pit group a small semi-circular levelled area is cut out of the slope. The seventh pit lies thirty yards from the pa and is 24 x 5 ft in dimension. Spoil has been heaped up on the lower side to form a bank, now a mound 4 ft wide. This mound extends across the south end of the pit and continues down and across the front parallel with the mound on the edge of the pit, forming a partial enclosure, banked on three sides. Between this pit and the others are two small terraces and low banks.

As well as exploiting the forest resources in the area, the pa inhabitants must have had access to the harbour mudflats as the shell midden testifies, and to agricultural land. Bartlett (pers. comm.) has collected local reports that 70 years ago the flats below the pa were a renowned Maori agricultural area, and Maoris returned yearly to cultivate the land.

Both personal observation and field recording have shown that in field configuration the pa, though small, is otherwise typical of many from the east coast of Northland. One of the larger of these is Parahaki (N20/101) on the high hill overlooking Whangarei. Such pa are usually situated on high steep peaks, and the terraces are extremely well defined, with scarps 6 to 8 ft high, sometimes reinforced with a stone facing. The wide terraces and very steep scarps make maximum use of the available land. Pa of this type commonly lack any form of ditch or ditch-and-bank defensive earthworks, even when, as in the case of Ruarangi itself, the topography is suitable for such features. In contrast to pa in other areas, pits are seldom if ever encountered on the terraces but, as in the case of Parahaki, can occur in large numbers on ridges leading up to the terraces. I have never encountered *rua* (underground pits) on any sites of this type, although there is a hint of some in a report on a pa near Kaeo, commonly known as Kaeo Mountain. This suggests that many years ago small "caves" existed in the scarps.

The Excavation

In total area Ruarangi pa covers approximately 1,660 m^2, of which perhaps 1,500 m^2 is level ground suitable for habitation. The main base line (Fig. 2), was laid out so that it bisected the three largest flat areas on the site, the resulting bearing being 164° east of magnetic north. An extension at a slight angle to the main baseline (Fig. 2) was made so as to bisect the outer scarp at the point of the main line of approach along the ridge. Although the area excavated covered only about 90 m^2 in all, which would be approximately 5.7% of the habitable space, it must still give a reasonable indication of the main activities and structures on the site, as each of the major areas was investigated. The three areas in which excavations took place were designated as:

Area A: the *tihi*

Area B: The wide terrace just below the *tihi,* and separated from it only by a low scarp

Area C: the largest area of level ground on the site, consisting of a wide terrace below Area B and separated from it by a high steep scarp.

Later extensions included excavations designed to investigate a mound on the surface of the *tihi* and a trench to investigate access to the pa from the ridge to the north of the site, just below the lower scarp. A 3 m grid was employed throughout, but the lay-out of the individual squares was largely determined by the presence of trees and their root systems which had to be avoided.

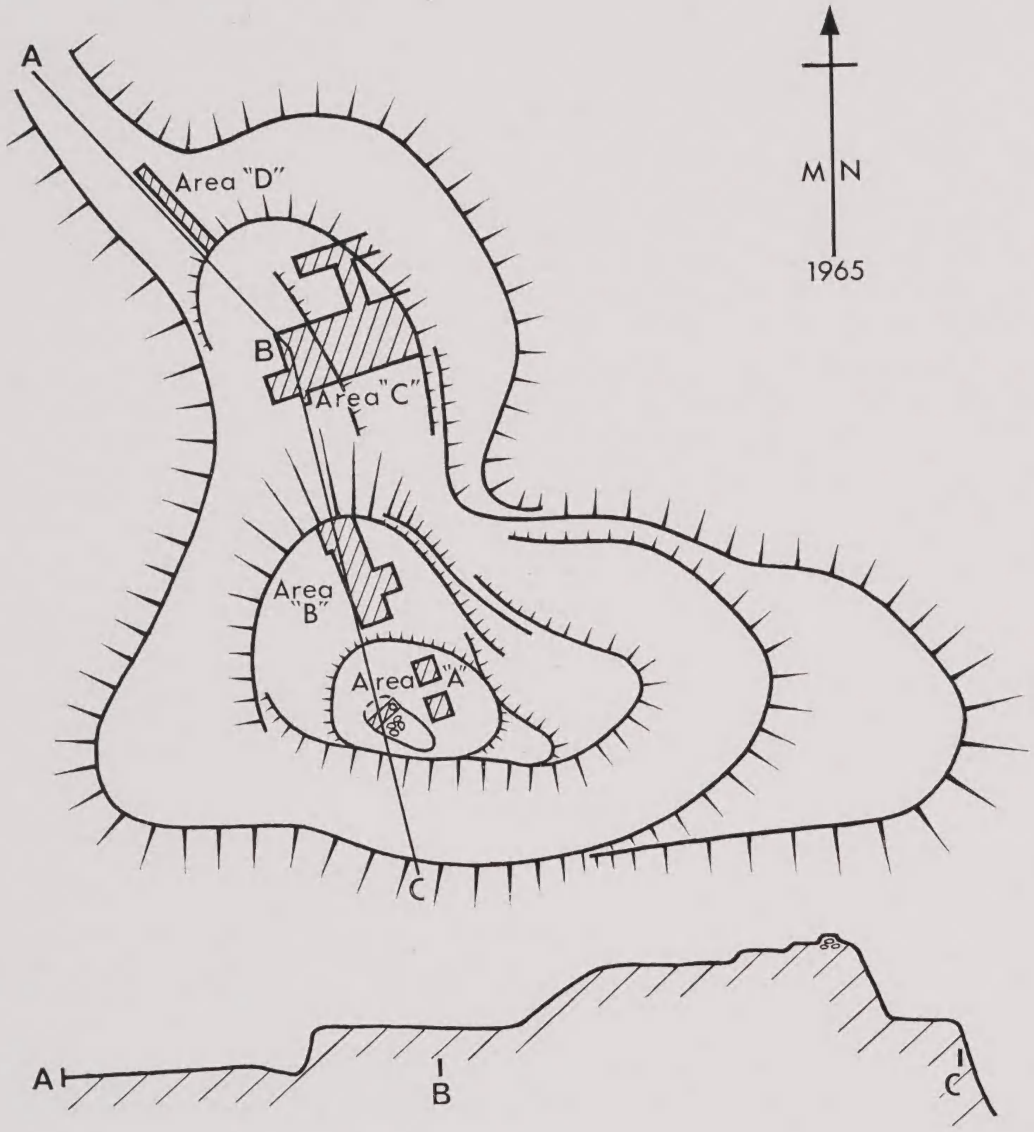


Fig. 2. Plan of Ruarangi Pa showing excavated areas.

No direct stratigraphic links were established between any of the areas, so each is best discussed individually. Possible correlations between the local sequences will then be dealt with in a separate section. In each area strata are initially discussed in the order of their discovery, with the upper-most deposit designated layer 1. Interpretations of the stratigraphic sequence, grouped into occupations, are numbered from earliest to latest. The term "occupation" is taken to mean a series of layers which appear to relate to one phase of living on the site. In this grouping no assumption is made that successive occupations must be separated by any great gap in time, nor is it assumed that they necessarily represent settlement by different groups of people.

Area A: The Tihi

Two 2 m squares, M 24 and 25, and a section through a low mound were excavated on the *tihi*, revealing that deposits there were shallow, the stratigraphy simple, and structural features few in number. This situation provides a sharp contrast to that encountered in Areas B and C discussed below.

Stratigraphy

Removal of the turf zone, *layer 1*, revealed a black soil deposit, *layer 2*, of fairly uniform thickness over the entire area (Fig. 3). Both layers yielded flakes of chert and obsidian, with the highest concentration to the side of the fire in square M-24. *Layer 3* was a brown soil zone containing lumps of clay and sandstone, and was formed on a hard clay-sandstone base rock which in places had also weathered to a lumpy clay.

Features

A circular depression 11 cm deep and approximately 1 m in width was encountered in the centre of square M 24 (Fig. 3—a). It was cut into layer 3 and contained burn marks and ash. A chert flake concentration lay to one side of the fire area. There were no associated oven stones, but there was a scatter of ash off to one side, apparently rake-out from some type of firepit. Square M 25 revealed only one stake hole (Fig. 3—b), cut either from the top of layer 2, or from nearer the surface. Some slight irregularities on the southern side of this square were probably related to the weathered top of a low scarp which showed on the surface in this area.

A bisecting trench was cut through a low long mound to the west of the two squares (Fig. 2). The northern end of the mound was covered with limestone slabs, but it was found that they lay loosely piled on top of the mound and did not penetrate the surface of layer 2. A few pieces of limestone lying just under the turf in the flat area beside the mound showed indications of burning. The mound itself was entirely composed of undisturbed sandstone and clay in which occurred the natural obliquely dipping strata typical of the area. The mound, therefore is to be interpreted as a natural remnant on which little soil had formed, and with no sign of the weathered and lumpy clay deposits of layer 3 encountered elsewhere.

The lack of features on the *tihi* is surprising. Either it was deliberately kept clear, or it was levelled at a relatively late stage in the occupation sequence of the pa. The area was certainly flattened at one stage, and the occupation on its top can with some confidence be related to the final occupation in the other areas.

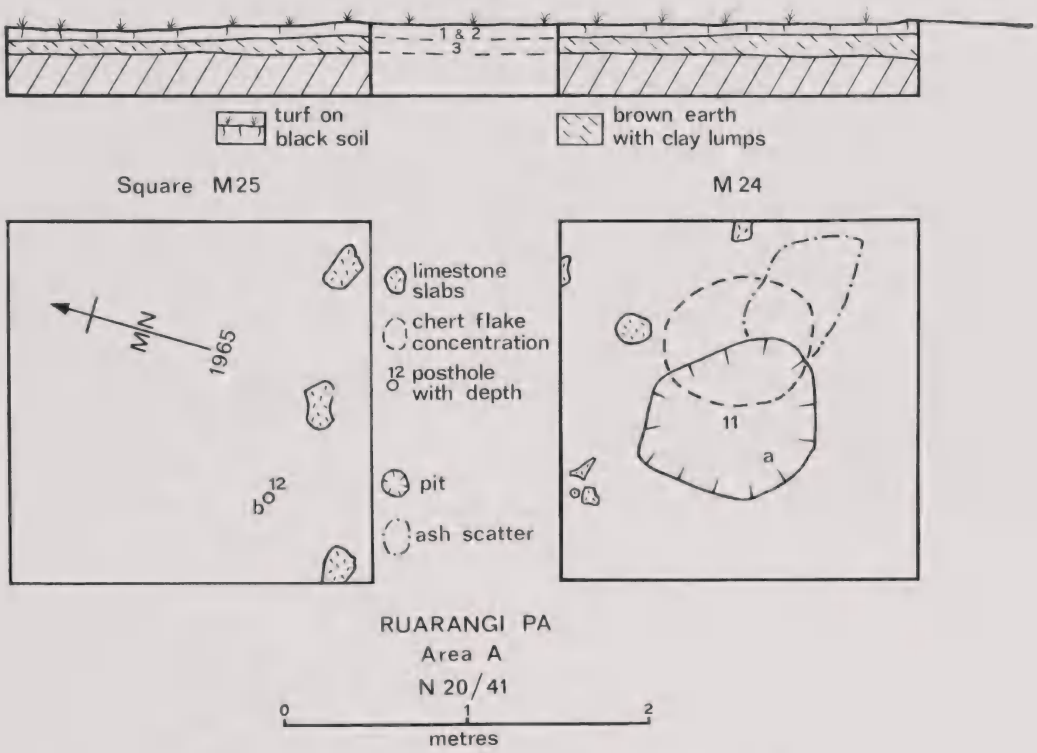


Fig. 3. Plan and cross-section, Area A, Ruarangi Pa.

Area B

The small terrace flat to the north of the *tihi* is separated from it by only a low scarp. The three and a half squares excavated in Area B were intended to provide a cross-section across the terrace from Area A and the low scarp to the higher steeper scarp which led to Area C below. It was also hoped to uncover structural features indicative of the use to which the terrace had been put.

Stratigraphy (Fig. 5)

Occupation IV was represented by the turf zone, *layer 1*, which had formed on *layer 2*, a black soil with a great deal of humus. Layer 2 contained numerous flakes of chert and some obsidian.

Occupation III comprised layers 3, 4 and 5.

The composition of *layer 3* was predominantly broken shell, with some large, whole pipi *(Amphidesma* sp.) both on top of and underneath the more fragmented shell. This layer was not continuous across the terrace, but was bounded on the two ends by the rising clay fills of the underlying terrace scarps. A few scattered limestone slabs were found in the layer but they did not appear to follow any deliberate arrangement. Incorporated in the layer as features were a number of ovens and one collection of oven stones, along with many more scattered oven stones. Several artifacts were also found in the layer. They include two broken adzes lying within a few centimetres of each other in the northeast

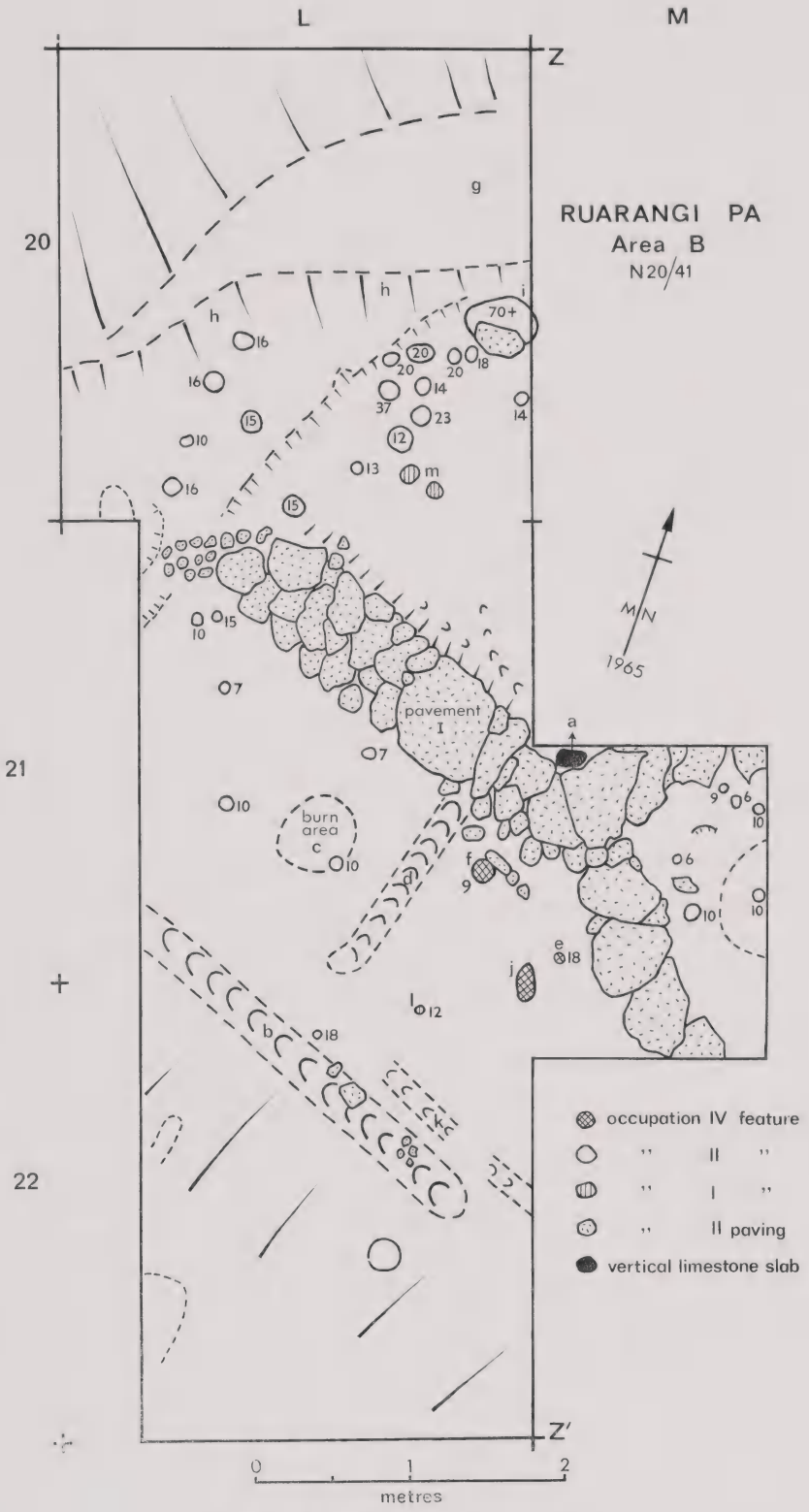


Fig. 4. Plan of Area B, Ruarangi Pa.

portion of square L 21. A flake from another adze was found here and this fitted with a flake from the same layer found in square L 20. One further adze, of Duff type 2B, was found in the spoil heap among the distinctive spoil from this layer, and therefore can probably be associated with it. A single upright limestone slab (Fig. 4—a), on the north edge of pavement I in square M 21 appeared to have been set from this layer. It protruded 7 cm above the turf surface.

Layer 4 was a mixture of ash and earth with oven stones and small pieces of shell. This layer was thickest to the northwest in the area of squares L 20 and 21. To the south it butted up against and in part overlay the limestone paving of layer 7. The preponderance of oven stones in layer 3, however, is demonstrated by comparison with layer 4. Used oven stones and burnt pieces of limestone occurred by weight in a ratio of 12 kilos in layer 3 for every 1 in layer 4.

Layer 5 was a discontinuous thin band of shell midden that became thicker toward the eastern side of the excavated area. It overlay the limestone pavement of layer 7 and the clay floor of layer 6, in places abutting against the sloping natural clay-sandstone base of the southern scarp.

Occupation II included the remaining layers, 6, 7, 8 and 9.

Layer 6 was an almost pure clay deposit, 1 - 2 cm thick, which appeared to form an artificially built-up floor. A shallow drain, 4 cm deep (Fig. 4—d) ran across this floor and disappeared under the limestone paving. Another drain (Fig. 4—b) at right angles to it, was cut into the southern scarp. After an initial filling of clay from higher up the slope (presumably formed by erosion during rainstorms) this drain was later filled with the shell material that covered the clay floor. An area with a burn mark was encountered on the surface of this floor in square L 21 (Fig. 4—c).

Layer 7 consisted of the limestone slabs which formed pavement I (Figs. 4, 6). This pavement partially underlay layer 6 and was formed of overlapping limestone slabs up to 1 m in diameter. While such slabs occur locally, they do not occur naturally in the clay and sandstone remnant on which the pa is situated, and thus must have been brought to the pa. This paving marked the boundary between the thick deposit of midden and ash belonging to layer 4 on the one side, and the clay floor of layer 6 on the other. At the northwest end the pavement narrowed and turned to the west, running down the slope and covering a shallow drain.

Layer 8 was a thin deposit of shell midden underlying the clay floor of layer 6 and continuing beyond it to the north down the slope. On the eastern side of square L 21 it had been cut away in places.

Layer 9 was another clay fill (unfortunately incompletely excavated) which appeared to form an earlier floor beneath pavement I. It continued down the slope to the north and, becoming abruptly thicker, formed a low irregular mound (Fig. 4—h) at the base of what proved to be a built-up bank of clay and sandstone boulders and rocks (Fig. 4—g). This bank had served as a retaining wall against which the later deposits had terminated (Fig. 5). The confused stratigraphy in the small area excavated could have been caused by tree roots but also possibly by the former existence of posts which later rotted. The two metre length of the bank which was uncovered did not entirely follow the line of the clay mound on which it lay.

Layer 10 was the underlying clay-sandstone bedrock. In square L 20 there was a black lens on its surface, probably the remains of the original soil on the site before human modification. Higher up the slope to the south this dark soil disappeared, and layer 9 lay directly on the natural clay.

Features

Few structural features can be assigned to Occupation IV. There were a number of depressions cut into layer 3 and filled with dark humus, which are of unknown function (Fig. 4—j). A stake hole (Fig. 4—e) in the southern portion of square M 21, cut into layer 3, contained the remains of a stake. A larger posthole (Fig. 4—f) on the east side of L 21 was filled with black earth and shell.

Occupation III was largely concerned with cooking. A number of ovens were concentrated in the northern part of the area excavated. All were about 60-70 cm in diameter, with their stones *in situ*. A large cluster of oven stones associated with this occupation was found lying on the clay bank, as if carefully put aside for a later occasion. Stakeholes which possibly belong to this period or later appeared to be cut from part way through layer 3, but were difficult to find until the lower and less disturbed layers were reached.

Occupation II consisted of the clay floors and their associated features. The earlier (layer 9) and later (layer 6) clay floors were separated by a thin layer of shell (layer 8), while the later floor lay partially over a broad lineal paving (pavement I). A number of postholes or stakeholes appeared to have been cut from the later floor (Fig. 4, square L 21; Fig. 7), although some of them were so shallow that they could well have been cut from a layer above and not identified at that stage. A 15 cm deep drain ran along the southern scarp (Fig. 4—b). This was cut part way up the low scarp, rather than at its base, and debris from the earlier occupations had already accumulated to this level when the later clay floor was laid. The drain began just below a deep posthole on the scarp, which was filled with the same material as the drain (Fig. 4). The drain itself ran to the northwest and was filled with a deposit which may have been part of layer 4, as the upper levels contained oven stones and pieces of limestone (Fig. 4 b). Another shallow drain (Fig. 4—d) at right angles to it, as mentioned above, ran across the floor to the northeast, disappearing under the paving (Fig. 7). Burn marks on the clay floor in the central area of square L 21 (Fig. 4—c), between the deep drain and lineal paving, indicate the position of a small fire, although there were no signs of a formal fireplace. The features in the central portion of Area B, then, including the clay floor, the drains, the limestone paving along the other floor edge, and scattered postholes, all suggest that this part of the terrace functioned as a residential area.

Similar evidence for the lower and earlier clay floor is not so extensive. Only one stake hole (Fig. 4—l) and no burn marks or fireplaces could be identified in the excavated area. There was a shallow drain (Fig. 4—k), however, which ran along the base of the low scarp and parallel to the later drain, although it was not as well defined. It belongs to the earlier clay floor.

Because of the state of preservation of the later clay floor the underlying sequence was discovered from limited test pit excavation and could well have been more complex than indicated here.

Fig. 6. Lineal pavement I, Area B, Ruarangi Pa, from the southeast.

To the northwest the lineal limestone paving (layer 7) became narrower and less well formed; smaller stones were used. Also, the sharp scarp on its northern side was replaced by a gentle slope. Here the paving turned to the west, covering a shallow drain-like depression which then ran off down the slope. The gently sloping clay fill (layer 9) in this area to the north of pavement I contained many postholes, all of similar depths, and all with fills of shell and loose clay towards their base (Fig. 4, square L 20). The main concentration of these postholes is around a deeper posthole (Fig. 4—i), too deep for its bottom to be reached. The clay edge formed by layer 9 thickened to the northeast, forming a bank which added considerably to the height of the steep scarp which led to Area C below. Later the height of the bank had been further increased by the use of clay and sandstone boulders to form a wall, as noted above, the remains of which showed slightly on the surface. No postholes were encountered on or in the portion of the wall surface

Fig. 7. Square L-2[illegible], Area B, Ruarangi Pa, showing part of pavement I, and the upper of two clay floors with associated postholes and drain.

excavated, and it appears that all wooden structures lay behind it to the south and not along the scarp edge.

Occupation I. A little evidence for an earlier use of Area B was recovered. In square L 20 two postholes (Fig. 4—m) sealed by layer 9 were identified which were cut from the top of the natural bedrock surface, and a stake hole was also found in L 22 (Fig. 4—l).

Discussion of Area B

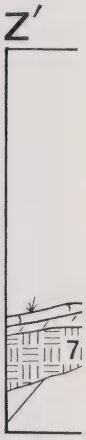
Traces of the initial utilisation of the area were meagre. One could possibly deduce that as the two postholes were cut on the slope of the hill, they related to defensive features rather than domestic structures. But it would appear that most

evidence of utilisation of the flatter area behind was removed, along with the original soil zone, when the area was prepared for Occupation II.

Occupation II comprised the major building activities which shaped the later use of the site. These included levelling the central portion of the area, by cutting a low scarp with ditch on the side adjacent to the *tihi*, and the building up of a clay bank along the steeper natural scarp next to Area C. Wooden defensive structures then appear to have been erected behind this bank, the most likely being a wooden palisade, although some sort of small fighting stage is not entirely ruled out. The addition of a boulder wall to the top of the bank must have rendered the wooden defences virtually useless, which suggests either that the postholes belong to something else, or that the palisading was later replaced by the stone walling with no supplementary wooden defences built on the wall. Unfortunately, as the question of preservation of the site had not been decided at the time of excavation, it was deemed unwise to remove the boulder wall to determine whether or not palisade postholes had been cut into the top of the clay bank. One could also suppose that later erosion has taken so much of this wall that the postholes have disappeared, or that better defences on the lower terrace put these higher defences out of use.

As mentioned earlier, this site, on the basis of field surveys, is typical of many in the Whangarei area. Thus it is interesting to speculate whether high steep scarps with stone banks may also be a feature of such sites and whether in this area wooden palisades as a defensive device were replaced by these earthworks. Vayda (1960, p.8) in a study of Maori warfare based on historical documents reports that projectile weapons were uncommon among the Maori. If such was the case, then one can well imagine that height could be more strategically advantageous than a palisade in defence. One could also imagine that the heavy soils and the high rainfall of Northland would tend to make the upkeep of wooden stockades a much more arduous task than in regions with dryer climates and lighter soils — thus favouring artificial earthwork defences over palisades, at least on those sites where the technique of a surrounding ditch and bank was not employed. All this is not to suggest that palisades or fighting platforms were not in use in Northland in the late prehistoric period for they almost certainly were on some types of sites (Kennedy 1969). Also, palisading is well attested in the early historic period (Maning 1863, pp. 40-41) by which time guns were also in use. But palisading need not have been universal on all types of terraced pa, so that there may be some meaningful differences between sites using palisades as supplementary defences and those using high artificial banks without palisades. Only future research, however, can decide this issue.

The problem of identifying archaeologically the houses or huts used for residences by the prehistoric Maori has been widely discussed (e.g. Groube 1965). Excavations at Paeroa village (Groube 1966), Ngaroto (Shawcross 1968) and Motutapu (Leahy 1970, pp. 62-63) have demonstrated the existence of floors and lines of stakeholes sufficiently distinctive to be interpreted as house or hut sites. These identifications receive further support from the excavations on this site. Here the inhabitants constructed well-drained clay floors, often (from personal experience) the only place not waterlogged on the site, built small fires on them, and put "housewifely" limestone paving along the sides of residences, which perhaps also served as relatively dry and mud free areas for outdoor activities and as paths for movement around the site. Thus the evidence suggests that the finding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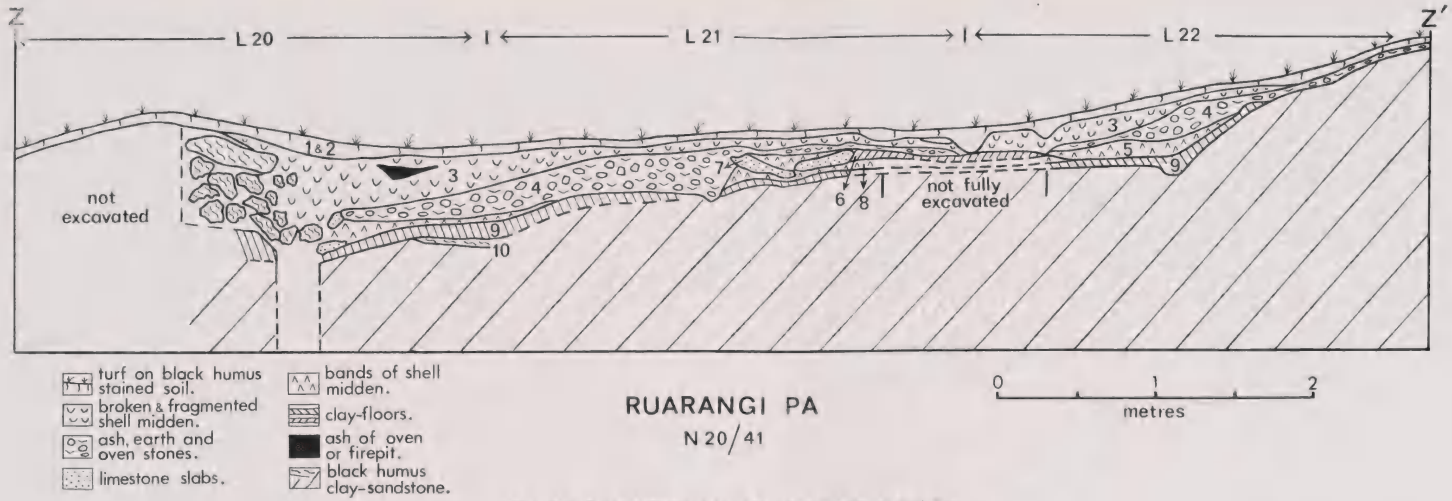

Fig. 5. Principal cross-section, Area B, Ruarangi Pa.

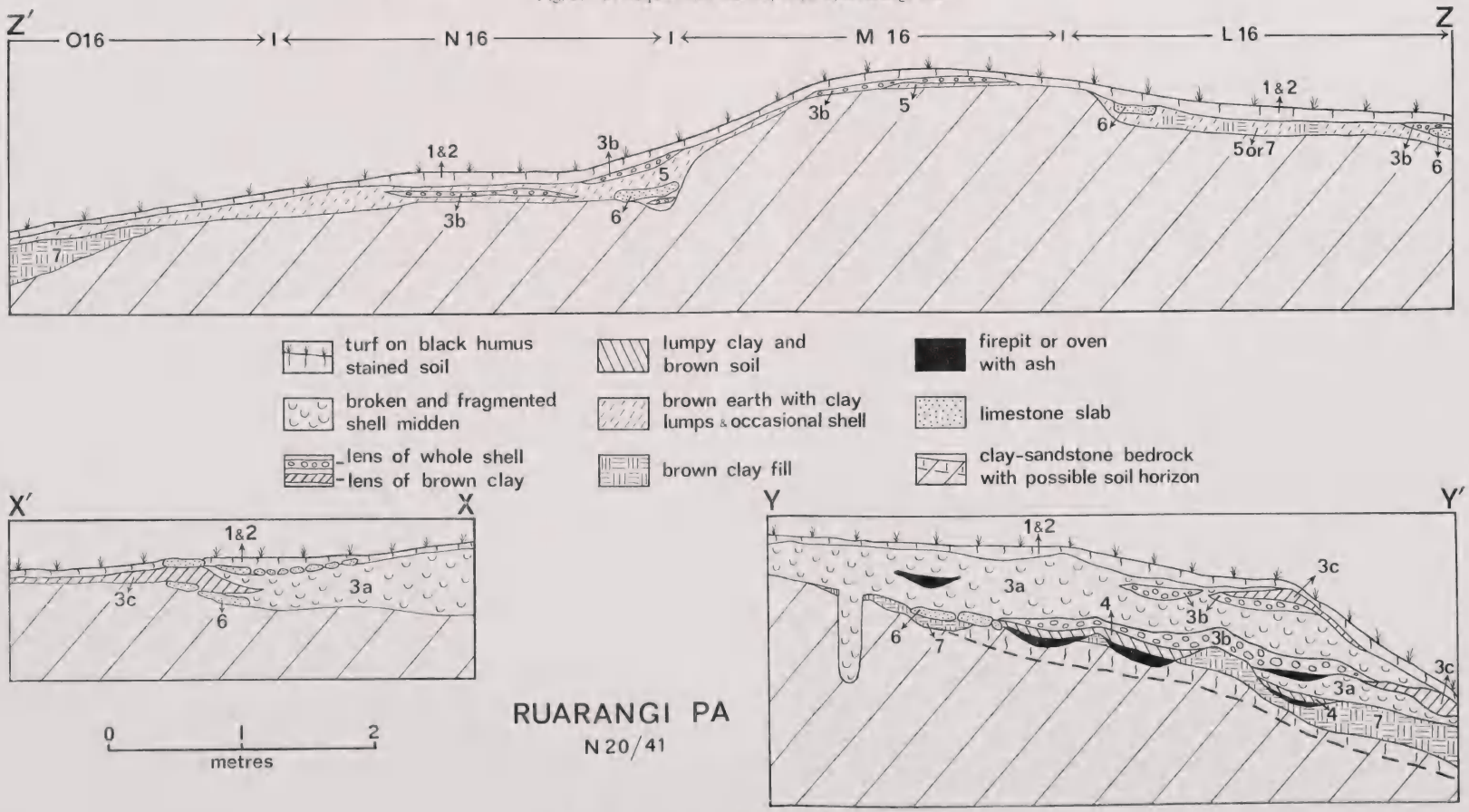

Fig. 9. Principal cross-sections, Area C, Ruarangi Pa.

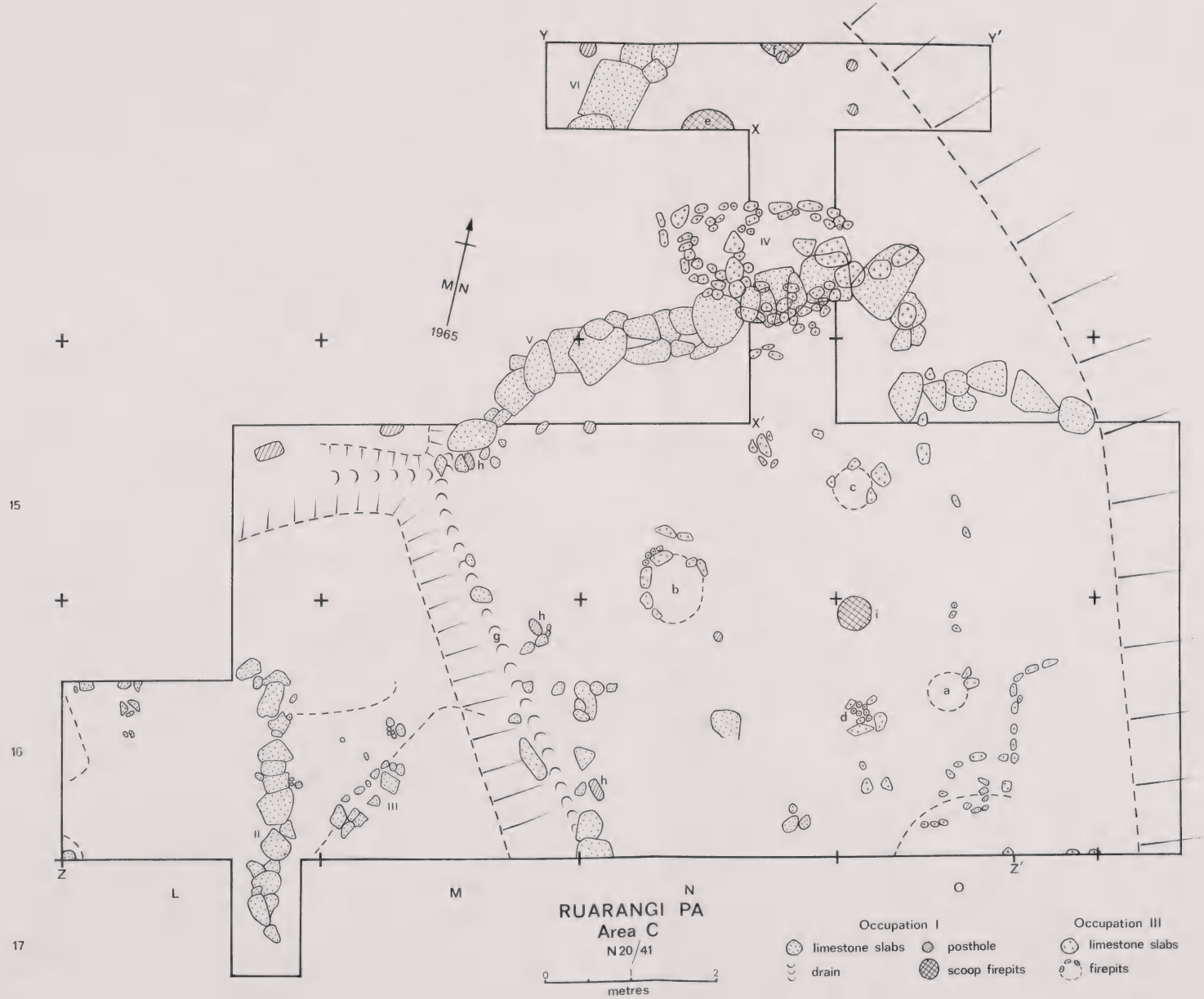

Fig. 8. Plan of Area C, Ruarangi Pa.

of stake holes in a pattern or line is not a necessary prerequisite to the identification of small residential huts, although without additional features such as were found on this site, the identification of these house floors and living areas must often be difficult or impossible.

The use of lineal limestone pavings on this site appears at present to be an isolated occurrence, not documented for other pa sites in New Zealand. Wilkes and Scarlett (1967, pp. 196-198) encountered much broader and more rectangular types of pavement at the Heaphy River Moa-hunter site which they interpreted as workshop areas, the stone slabs being laid to prevent the areas from becoming too muddy. They noted that similar pavements 15 ft (*c*.4.6 m) square were recorded at the Moa-hunter site at the Waitaki River mouth *in addition* to the more usual hut sites. Lineal alignments of slabs to cover drains in two pits of a pa on Great Mercury Island were found by Golson (1955, p. 351) and a similar occurrence has been described for Hamlins Hill south of Auckland (Davidson 1970, p. 110). Some of the slabs in Area B and more in Area C cover drains, but the majority on this site appear to be intended as a tidy means of providing mud free areas for outside activities and movement around the pa and in this sense are more similar to those recorded for the South Island Moa-hunter sites. None, of course, are here associated with pits. One could imagine, however, that on other pa sites organic materials were employed instead, but only in such exceptional circumstances as swamp pa would they be preserved.

That the "clay floor" people of Occupation II and the "midden people" of Occupation III were one and the same is a common-sense view, although archaeologically there is nothing to demonstrate it conclusively. However, the differences between the features which characterise each occupation are largely those reflecting differences in the use of a particular area for one of several types of activity; such a shift as has frequently been encountered with excavations of pa. There is some doubt of the extent to which the earlier of the two clay floors associated with Occupation II was ever used for habitation, at least in the area exposed by excavation, but it is most likely to have been a living area. Both floors are overlain by midden, which in the case of the upper floor (layer 6) is fairly extensive, and it may be that in both instances all that happened was that localities for a specific activity shifted, and what was formerly a residential area was transformed into a cooking and kitchen area. It is also likely that midden material was deliberately and evenly laid over the earlier floor to give a better drainage for the later inhabitants. In addition, the midden, either intentionally or unintentionally, served as a fill which raised the ground level behind the clay and boulder wall on the north side of the terrace as well as that against the low terrace scarp on the south side.

In the midden belonging to Occupation III, in contrast to the earlier midden levels, ovens with their cooking stones, or *haangi,* were found incorporated within the layer. This is interesting, as one would imagine that heat retention in a layer of this composition would be inferior to that in the more usual clay or earth. From the evidence of the heap of oven stones that lay on the bank, it also appears that oven stones were often re-used, though the large quantity contained in the layer suggest that some were scattered or lost after each use.

A possible explanation for the addition of the boulders to the clay bank next to the steep scarp leading to Area C could be that as the midden mounted higher and began to spill down the scarp slope, the boulders were added to hold it

in place. The boulder wall would then be for housekeeping as well as, or instead of, for defence. The source for the material could easily have been the *tihi,* which was apparently levelled at some relatively late stage in the occupation sequence so that no features of any earlier occupation remained. This also fits with the fact that the limestone slabs, presumably from an earlier pavement in this area, had been carefully collected and laid aside, but not then re-used.

Flake tools were concentrated in the layers associated with Occupation IV, and other tools were uncommon at all levels. Only occasionally was an entire adze of the 2B type "lost" in the midden debris, the other specimens from the midden all being broken fragments that had been discarded.

The final occupation in Area B exhibits few traces of former structures, or other signs of major building activity. Fair numbers of chert flakes, and a few obsidian flakes, both absent from earlier layers, were encountered, some in concentrated clusters, and a few stake holes, which were hard to identify in this layer, were recorded. The sudden and late appearance of chert flakes in the sequence, gives a probable correlation with the Area A occupation.

Area C

In Area C two rows of squares, M, N. and O of columns 15 and 16, were initially excavated, exposing a number of features similar to those encountered in Area B. Extensions to the excavation were made some months later in order to verify particular points. In general, as with Area B, the aim was to determine the uses to which this largest area of flat ground on the pa had been put, and in particular to determine the existence and type of wooden defensive devices, if any, placed along the outer edge of the terrace scarp. Where paving was encountered its extent was followed outside the area of the main excavation.

Stratigraphy

The last Occupation, III, was here represented, as in the other two areas, by a turf zone, *layer 1,* formed on a black soil, *layer 2,* containing a high proportion of humus. Several features were associated with layer 2, (in contrast to Areas A and B), including a pavement (Fig. 8—IV), composed of small slabs in limestone, and several well defined fireplaces (Fig. 8—a,b,c,d), along with the usual flakes of chert and obsidian.

Occupation II consisted of layers 3, 4 and 5.

Layer 3 was composed of a number of minor lenses and beds. The main portion of layer 3 was a midden build-up composed of shell and ash, concentrated for the most part on the northeast end of the site, where thick deposits of it were encountered in the trench extensions. However, lenses of almost pure whole shell and other lenses of lumpy clay occurred both within and at the base of the main midden build-up. In addition, shallow ash-filled hearths occurred at a number of points in it (Fig. 9). Finally, similar shallow lenses of broken shell and earth occurred under layer 2, and on top of other layers at scattered points over the rest of the excavation area. All of these were probably a part of the layer 3 complex.

In the section at the north end of Area C (Fig. 9—Y-Y′) the main midden build-up of broken shell fragments, ash, and charcoal is easily identified. Within

the layer were several pockets of pure shell (Fig. 9—3b), one lens of which was fairly extensive and, except along the very edge of the scarp, lay at the base of the main midden build-up. At two points lumpy clay fills were added (Fig. 9—3c) along the edge of the terrace scarp to hold the midden in place. The first time was near the beginning of the dumping process, and the second towards the end. Another clay bed of material of very similar composition was found over pavement V, where it appeared to have been deposited after the midden build-up began, but well before it ended, so that it inter-fingered with that deposit in the middle of the build-up (Fig. 9—X-X′). Its function appears to have been as a retaining wall which held the midden from spilling out into the area to the south. In the section along the southern side of the excavated area, typical lenses of shell can again be seen (Fig. 9—Z-Z′) lying just under layer 2 and on top of or within layer 5 (layer 5 in this area was made more complex by the likelihood of similar or identical fill eroding from Area B). These shell lenses can also be assigned with some certainty to layer 3.

Layer 4 was a very localised deposit of lumpy clay and brown soil found along the northeast edge of the terrace scarp, where its function seems to have been to cover over a number of hearths and even out the ground surface in that area (Fig. 9—Y-Y′). Its position suggests that it was either material eroded from the terrace flat behind, or, more likely, material dug away in levelling some part of that area, and redeposited on the irregular slope.

Layer 5 was a more widespread deposit of brown earth with clay lumps and some shell encountered in squares M 15, N 15 and 16, and O 16 and 15. It overlay pavement V higher up the slope in square M 15, while further down the slope it lay under the tip of the clay lens, 3c, which in turn formed the retaining wall that kept the main midden of layer 3 to the northeast of this same pavement. As clay lens 3c overlay pavement V and underlay pavement IV of layer 2 at this point (Fig. 9—X-X′), the stratigraphic position of layer 5 seems fairly certain to have been earlier than the layer 1, 2, 3 complex, but later than pavement V and the drains of Occupation I. This is supported by the fact that a similar brown earth with clay lumps and some broken shell was also encountered under layers 1 and 2, or scattered lenses of layer 3 midden, in the section along the southern side of the excavated area (Fig. 9—Z-Z′). Again this layer overlay a limestone slab and the fill of the drain along the base of the scarp in square N 16, a drain which at its other end ran under pavement V. Thus layer 5 must represent the accumulation of debris in this area at a time slightly earlier than the dumping of the main midden build-up at the northeast end of the site.

Pavements V and VI, and the drains at the base of the scarp in row M can all be shown to be contemporary. The lineal limestone pavements belonging to this period have all been assigned to layer 6. However, the pavements II and III (Fig. 8), on the slope above the scarp which divided the excavated area into a lower and upper flat, are not so easily placed, because no stratigraphic links could be established to a deposit found below these two pavements in squares L and M 16 (Fig. 9—Z-Z′). One could argue that all the lineal limestone pavements were contemporary, in which case the underlying deposit was, like those elsewhere, a part of the layer 7 complex. This conclusion can be justified, as the layer 5/7 deposit lay at the base of the Area B scarp, and the overflow of material from the higher area could well have locally changed the layer 7 deposit. However, the composition of the deposit as it existed at the time of excavation, was a brown

earth and shell fill more similar to layer 5, while a lens of broken shell midden probably assignable to layer 3 abutted against pavement II. Thus a case can be made that these pavements were of later date than the others and reflected an occupation more or less contemporary with the main build-up of midden layer 3, to the northeast. If not they belong to Occupation I.

Occupation I consisted of layers 6 and 7.

Layer 6 included all the scattered limestone slabs, lineal pavements V and VI, and the drains associated with them. It may also have included pavements II and III, and the drain associated with them, if these features, because of their uniformity in construction and position in the stratigraphic sequence are considered contemporary. The features of layer 6 either rested directly on the natural soil formed from decomposed bedrock, *layer 8*, or lay on *layer 7*, a brown clay fill encountered all along the outer scarp of the terrace edge and in discontinuous patches in other places. This fill probably derived from the decomposed soil on top of the bedrock which was removed in levelling the lower flat by cutting the scarp and digging the drains which divided it into areas. In the trench at the northern end of Area C, a remnant of this soil horizon remained in position under layers 4 or 7.

Layers 4 to 7 could easily be considered as very nearly contemporary, i.e. all having to do with a series of events involved in the initial levelling and transformation of Area C into a place suitable for habitation (layers 6 and 7) which was then used and modified (layers 4 and 5).

Features

Occupation III features included four round or oval hearths outlined by limestone blocks (Fig. 8 — a,b,c,d), and a broad irregularly shaped "floor" made from small pieces of limestone (Fig. 8, pavement IV). The chert and obsidian flakes were concentrated around the hearths and also over the paving. This broad paving was similar to those at the Heaphy River site in the South Island mentioned above, and the concentration of flakes on its surface also parallels the situation encountered there; a similar concentration of flakes was encountered on the unpaved house floor at Motutapu (Leahy 1970). Two adzes of Duff type 2B were found on the southern part of the paving, where the greatest concentration of flakes also occurred. A careful search gave no indication of post or stake holes in association (again similar to the Heaphy River site), but the loose nature of the midden on which the paving lay may mean that any stake holes which had been there were no longer able to be identified. The interpretation of the paving as a workshop area, however, seems assured and its designation as a house floor very likely. The adjacent area with its hearths, flakes, but no obvious post or stake holes (again they may be lacking because of difficulties in identification) is best interpreted as a living area.

Occupation II may or may not have included pavements II and III. It is convenient, however to describe them here. Pavement III, which was in very poor condition, lay almost on the surface and formed a line roughly dividing the thin soil deposits over the scarp from the deeper earth and midden deposits to the west. Pavement II was of lineal form and consisted of a line of large stones laid over a shallow drain. The midden build-up associated with this occupation contained in it several hearths, but no ovens as in Area B. The use of clay lenses to hold the midden in place has already been discussed.

Occupation I was associated with a number of lineal pavements, a system of drains, and several hearths. Thus lineal pavements II and III were probably associated with this occupation and pavements V and VI certainly were. As well, there was a scarp approximately 50 cm high running north-south through the main excavated area, at the base of which ran a shallow drain (Fig. 8 — g). Parallel to the drain and base of the scarp and set out from it some 50 cm was a series of three postholes, of elongated oval shape (Fig. 8 — h) all about 20 cm deep and separated by intervals of two metres or more. They were probably the main supports for some kind of fence which divided the lower area from the one behind. The drain at the base of the scarp was joined by a deeper channel which cut through the scarp to the higher area behind. Down the slope it joined the drain which then disappeared under the large slabs of pavement V until it made its way, after an abrupt turn to the south and then east again, to the outer terrace scarp. The scoop hearths associated with this occupation consisted of one in the centre of the terrace flat (Fig. 8 — i) and two at the northern end of the excavated area (Fig. 8 — e,f). Only one posthole was identified on the main terrace flat and another on the upper terrace. Although several deep postholes were encountered at the northern end of the site, insufficient area was exposed there to indicate the nature of the structure they represented. What is certain is that no extensive line of palisade posts lay along the outer edge of the terrace scarp and it appears that the perimeter defences for this area of the pa were minimal. A 2B adze was found next to one of the stones of pavement V, but there were no other finished portable artifacts.

Area D

To the north of the site, below the main outer scarp, a slight hollow ran across the ridge at the point of the most easy natural means of access to the site. It was thought that this hollow might represent an infilled ditch. A test trench showed, however, that the dip was a feature which resulted from a build-up of clay to the north on what appeared to have been an artificially flattened ridge top. Once this was determined, the area was not further investigated. Area D provided additional evidence that the low outer scarp was not supplemented by other defensive features.

Relationships Between Excavated Areas

The probable relationships between the occupations described above for each of the separate areas may be set out as follows:

	Area A	Area B	Area C
III	Occupation I	Occupation IV	Occupation III
II	.....	Occupation III	Occupation II
I	.....	Occupation II	Occupation I
?	.....	Occupation I	.....

The only traces of the earliest use of the site were a few features in Area B that were stratigraphically earlier than the first major occupation of the site. It was at the time of the initial major occupation that the site took on the main outlines of its final shape, all the principal levelling, definition of areas, and building up of

scarps being done at that time. As well, most, if not all the lineal pavements were constructed at this time, often in association with a simple system of drains around the major living areas. That this major phase of construction was the work of a single group of people can hardly be doubted; that the major part of the midden build up which followed in Areas B and C was also the work of the same people seems likely. But this would require excavation of a larger area before it could be said with conviction. Thus separate occupation numbers have been retained, although they may only reflect different stages in the same occupation.

The final occupation, with its greater quantities of flakes often occurring in localised concentrations, was encountered over the whole of the excavated area. It must also have been the work of one people, who seem, however, to have been slightly different from their predecessors, as the type of house floor and hearth they employed were both different. Thus while the midden build-up by this time may have been sufficient that drains and lineal pavements were no longer necessary, a broad house pavement and round hearths outlined in stone were employed and clay house floors and scoop hearths, which would still have been quite functional, were not.

No European artifacts were found on the site. On the other hand, nothing diagnostic of the Archaic culture complex was discovered, so this site, along with so many others, must presumably belong in the long period in between. Traditional evidence is detailed in a separate paper (see Oppenheim, this volume). C14 dates are not available.

Midden

Samples of the midden were taken from layer 3 in Area C and from layers 3, 4 and 5 in Area B (see Table 1). Of these, only sample 5 exhibited any marked difference, and this appears to be rather in the small size of the pieces of shell.

Table 1. Composition of midden samples by weight.

	SAMPLE 1 Area C Sq. M16 layer 3	SAMPLE 2 Area B Sq. L20-21 layer 3 top 6"*	SAMPLE 3 Area B Sq. L20-21 layer 3 bottom 6"*	SAMPLE 4 Area B Sq. M21 layer 5	SAMPLE 5 Area B Sq. L20 layer 4
Total weight	73oz (2069g) %	74oz (2098g) %	94oz (2665g) %	100oz (2835g) %	43oz (1219g) %
Chione stutchburyi	34.76	48.45	42.1	46.24	10.22
Amphidesma australe	3.09	2.61	6.69	x	—
Amphibola crenata	0.27	8.08	4.46	16.82	—
Leptomya retiara	—	—	x	—	—
Zeacumantus lutulentus	—	x	x	—	—
Cominella sp.	—	x	—	—	—
Zethalia zelandica	—	x	—	—	—
Pecten novaezelandiae	—	x	—	—	—
Residue	61.98	40.39	44.52	36.94	89.78

x present in small quantity * (15.24cm)

only about 10% of which were readily identifiable. The samples confirm the initial impression of the high porportion of cockles (*Chione stutchburyi*), with smaller amounts of pipi (*Amphidesma australe*) and mudsnails (*Amphibola crenata*). Thus this midden is typical of many in the North Island found in association with pa and as beach and dry land middens separated from such sites.

Adzes

Six adzes, plus a few fragments of polished stone, probably chips from adzes, were recovered. All the adzes were of one type, 2B in the Duff classification. Two adzes were broken and the blade end only recovered. One other adze was broken at the blade end, although sufficient remained for its measurements to be taken. Measurements of width and breadth were taken half way along the length of the adze in the absence of any true shoulder (after Green and Purcell 1961) and the results recorded in Table 2. As noted above, these adzes were found in all three of the main occupations. They are made from a variety of local stones, the most remarkable being one made from a type of hard sandstone. One specimen, of which only the blade end was recovered, has an obliquely slanting cutting edge, which if viewed in cross-section would appear to run from the front corner on one side to the back on the other, instead of lying parallel to the back and front surfaces.

Table 2. Description of adzes

CONTEXT	cross-section	length (cm)	blade width (cm)	width (cm)	thickness (cm)	REMARKS
Paving IV Area C Occupation III	quadrangular	6.6	1.6	3.9	2.0	no butt modification
Paving IV Area C Occupation III	quadrangular	11.3	3.1	7.2	3.1	rough butt
Paving V Area C Occupation I	quadrangular	12.0	—	5.1	2.5	no butt modification, no defined blade, made of sandstone
Spoil heap, Area B Occupation III (?)	quadrangular	—	—	7.8	4.2	blade only oblique edge
Area B sq L21 layer 3 Occupation III	quadrangular	—	3.1	5.6	2.7	blade only
Area B sq L21 layer 3 Occupation III	quadrangular	9.3	3.0	5.0	2.7	roughened at butt

Other Artifacts

A fragment of worked paua (*Haliotis iris*) was found in midden layer 3 of Area B. It is possible that it had been part of a composite fish lure.

Flakes of chert were common in all areas during the final occupation, but uncommon in earlier ones (Table 3). In Area A the flakes were mainly small and were concentrated almost entirely in and around the hearth. There were six small cores from this area and over 15% of the flakes have small notches,

Table 3. Distribution of chert and obsidian.

		CHERT		OBSIDIAN	
		total	with use or wear	total	with use or wear
Area A:	Occupation I	232	34	5	1
Area B:	Occupation IV	16	—	3	1
	Occupation III	6	—	—	—
	Occupation II	1	—	—	—
Area C:	Occupation III	156	5	2	1
	Occupation II	12	1	—	—

possibly use marks, on one or more edges. Far fewer flakes were found in Area B, where they were concentrated in two areas. None showed use marks. In Area C the flakes were concentrated around the hearths and stone floor of the latest occupation. A few also occurred in the midden under pavement IV; it is likely they had worked down from the floor itself. The flakes from Area C appeared larger than those from other areas and very few showed signs of use.

Obsidian flakes were rare and were confined to the final occupation.

Summary and Discussion

The site described in this excavation report was a small ridge-peak pa in the Whangarei area, which except for its smaller size is quite typical of many in this part of Northland. The only field evidence of structural features on the site was a number of well defined terraces. These were separated into three areas: Area A, a *tihi;* Area B, an inner terrace with high scarp; and Area C, a lower terrace with lesser scarps. Each area was investigated. Pits were not found on the site, although pits were present just below the pa and are known from the general area.

Excavation showed that palisading was probably used as supplementary defence for the central area of the site (Area B) during the early period of occupation, but was then replaced by artificially built-up high steep scarps without surmounting palisade. Ditches, or ditch and bank earthworks were at no point employed for defence. Palisading marking internal divisions in Area C was in evidence, but there was no sign of such palisading around the upper perimeter of the outer terrace scarp. Thus supplementary defensive devices were probably always minimal.

Two types of house floor were discovered. The earlier consisted of clay floors, often over a layer of shell with the associated midden just outside the "front door" and divided from the house by a line of limestone slabs. Hearths were simple, fires being lit on the clay floor or in scoop depressions, and were not outlined in stone. Stakeholes for the house structures were small and irregular. A network of drains around the living areas served to remove the water from the site.

The later house floor was of small limestone slabs which lay over the earlier midden. Hearths associated with this occupation were oval and outlined with

limestone slabs and blocks. Flakes of chert were associated with both the hearths and the floor in contrast to the earlier occupation levels, although this may be a fortuitous occurrence. Both types of house floor postdate the build-up of the scarp and the obsolescence of the palisade.

Midden samples from the different layers and occupations showed no significant variation in composition, all reflecting exploitation of the local mud flat and beach environment of the nearby harbour. It is possible that the midden, if any, belonging to the last occupation was not excavated.

While the extensive use of chert and some obsidian flakes is well attested only for the last period of occupation, adzes of the 2B type appear to have been in use through almost the entire sequence.

The relationship between the use of the pa as a place of occupation and the use of the surrounding area as a burial ground is not known. The *tapu* or sacredness of the area as it now exists could well be an extension of an earlier more restricted *tapu*. One could imagine, for example, that the big cave, Ruarangi, was used for burial when the pa was occupied, but because of its character and size remained in use after the pa was abandoned, at which point the wider area also was included as part of the burial ground. This, however, is pure conjecture. Oppenheim (this volume) records the sequence of events as far as it can be inferred from tradition.

The identification of "house floors" on the site is only one instance of their discovery and identification after extended discussion in the mid 1960s of their hypothetical existence and probable form. It constitutes, however, an important demonstration of their existence on small terraced ridge-peak type of pa.

The evidence from Ruarangi pa also suggests a sequence from palisade to artificially steepened scarp defence, and a separate sequence from clay-shell layer house floors with unlined hearths to entire limestone house floors with adjacent round hearths outlined with slabs of stone. How far either sequence is meaningful for other pa in the Whangarei area, or in other areas, can only be determined by future research. It is a continuing matter of regret to me, that neither I nor any other person was able to continue with the excavation of this pa.

Acknowledgements. I would like to thank the Maori Trustees of the burial ground, the Judge of the Maori Land Court, and Wilsons Portland Cement Co. for making the excavation possible. I would also like to thank all those who helped with the excavation. I am grateful to R. C. Green and J. M. Davidson for helpful criticism of the manuscript.

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THE BURIAL SYSTEM AT RUARANGI BURIAL GROUND

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Abstract. The burial system at Ruarangi is described, and traditions concerning the occupation of Ruarangi Pa and the use of the Burial Ground are summarised.

This report discusses the burial system at Ruarangi as it has been reconstructed from an investigation of the Ruarangi Maori Burial Ground. The general nature of the locality has already been described in a report by Hougaard (this volume). That part of the Reserve in which the burials are located is estimated to cover some five of the forty acres (two of the sixteen hectares). Here the limestone cap consists of outcrops of flagged crystalline limestone which provide convenient locations for hiding bones, one major cave, Ruarangi, and a number of deep depressions which are the result of subsidences in the limestone. Although there are no permanent springs, the high rainfall of the Whangarei district combined with the high permeability of the limestone, creates wet conditions underground much of the year. Thus the clefts and cysts of piled limestone provide somewhat drier conditions than those deep within the cave system.

Agricultural use has left much of the block in rough pasture, though the burial area is covered by second growth native species and scrub with some taller trees. A significant botanical characteristic is the presence of a grove of karaka *(Cornyocarpus laevigatus* J. R. & G. Forst.) trees. These groves are commonly associated with Maori sites since the berry of the karaka, after suitable treatment, was regarded as a delicacy. There is some suggestion then that these trees may have been deliberately cultivated, or be the descendants of cultivated trees.

The Ruarangi site is unfenced and has been subject to the trespass of stock over many years as well as that of wild pigs which come out of the surrounding scrubland. This has resulted in a certain amount of damage, but less than that inflicted by picnic parties which visited the area in the early part of the twentieth century. There seems little doubt that Ruarangi cave has been well explored by curio hunters but minor burial places appear to have escaped their attentions.

TRADITIONAL HISTORY

The Ruarangi burial complex must be viewed in the light of what is known of northern Maori burial custom. The following stages characterised Maori burial. After death the body was trussed with knees under the chin and maintained thus for the mourning rituals which occupied a period of several days, after which it was removed to a sacred place *(waahi tapu)* where it was exposed until the flesh had decayed. Social, cultural and economic factors determined the final phase of the ritual cycle, but in general this seems to have been made to coincide with the end of the agricultural cycle when a sufficient surplus was available for the required feasting and gifts.

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The body was removed from the *waahi tapu* and the bones scraped, decorated with red ochre and after the completion of the rites hidden in the burial ground, commonly a place removed from dwelling areas and known to relatively few people.

The reasons for this secretiveness were that the dead were supernaturally dangerous *(tapu)* to the group to which they belonged, and that desecration of bones frequently accompanied or was a cause of, intergroup warfare. Burial grounds were thus stringently protected by *tapu* from the chance intrusions of the local population, though these restrictions were ineffective, apparently, against invaders.

This then accounts for the comparative ignorance of the local Maori population concerning Ruarangi. The area has been avoided by all but a few Maoris down to the most recent times. It is still regarded by some as dangerously *tapu*.

Relatively little remains of the traditional history of Ruarangi, or rather, this assertion must be qualified, relatively few informants can be persuaded to talk about tradition. The nature of traditional history among Maoris is fragmentary and it is only by the gleaning and comparison of these fragments that tradition can be established. The presence of various millenarian theories, attempts at syncretisms between Christian and Maori mythology and the like render the task more difficult. The Maori imagination has been a fertile seed bed for almost every minor mysticism that has sought proselytes in this and last century.

Reduced to their simplest and most reliable details however the following traditions seem to have some reliability.

The Ruarangi pa was founded by an ancestor named Torongare who lived eleven generations B.P. or perhaps between 200 and 300 years ago. A high limestone feature on the site is called *Te Nohoanga o Torongare*, Torongare's Seat, from which he is said to have kept a lookout for raiders. At a meeting of the then elders of the district on 2 June, 1905, it was declared that the burial ground was traditionally known as *Te Pouaka o Ruangaio,* Ruangaio's Chest, with the additional information that the "deceased issues" of Ruangaio were buried there. Ruangaio appears, on the one genealogy available to the present writer, two generations below Torongare, that is nine generations B.P. It is significant also that the term *pouaka* refers explicitly to a type of burial chest or house in which relics were kept.

If this account is compared with the archaeological evidence, the 'fit' is reasonable and would lead to a reconstruction of a sequence such as the following —

(a) Occupation of Ruarangi by Torongare and his followers.

(b) Desertion of the pa.

(c) Use of Ruarangi cave as a burial place.

(d) Use of areas outside the cave for burials.

The sequence can be argued for on the following lines —

1. There was an absolute rule that burial places must be avoided by the people whose dead were placed in them. All the documentary evidence supports this. It is extremely unlikely therefore that a residential site would be occupied concurrently with its use or the use of any part of it as a *waahi tapu,* although in extreme circumstances a pa might be used as a defensive position. (There is traditional evidence that Taratara, a *waahi tapu* in Whangaroa country was so used in 1826). Nonetheless the pa site at Ruarangi is widely strewn with midden material which indicates some continuity of residence.

2. The archaeological evidence suggests a relatively short occupation. Two generations, from Torongare to Ruangaio appears not unreasonable.

3. The burials in the Ruarangi cave outnumber those outside the cave for which the possible alternative explanations can be advanced —

   (a) Ruarangi cave was used first as an ossuary and later abandoned because of the effects of water and rock falls;

   (b) the outside burials represent a differentiation of rank.

Only a full analysis of the skeletal material, so far not permitted by the owners of the land, would establish the first, since it would then be possible to establish the proportions by age and sex of the skeletons. The alternative would suggest that the burials would be distinguished by something other than their placement, the presence of grave goods for example. These have not been found even though the outside burials appear to have escaped from curio hunters. It is not impossible of course that both explanations may apply or that the phases may be reversed, though this seems hardly likely in view of the fact that a large and relatively accessible cave existed to which the term *pouaka* could reasonably be applied.

The Burial System

The burial system at Ruarangi does not appear to differ from that of other Northland sites with the exception of the variety of locations, a result perhaps of the physical variability in this locality. The preliminary exposure of bodies is most likely to have taken place on the many low outcrops of limestone which occur on the site. Sufficient numbers of bone fragments appeared in crevices in these outcrops to suggest this, but a European resident from nearby pointed out a large and certainly old puriri *(Vitex lucens* Kirk) tree (girth 4′ 6″ (1.37 m)) which she maintained had been pointed out to her when a child by an elderly Maori as a tree in which corpses had been hung for decay. There appears to have been no ideological reason for selecting trees for decay platforms but they are mentioned by a number of 19th century diarists and travellers. The possibility then that this tree was used must depend on botanical rather than archaeological evidence, unless, of course, the site was used in the traditional manner within living memory.

Burials at Ruarangi can be classified in three categories.

Type A. Cave Burials.

These burials occur only in Ruarangi cave. The bones in the cave were nowhere discovered in serial position and were indeed scattered over the whole area of the cave floor. As the result of subsidence of the floor and falls from the

roof, the floor of the cave was exceedingly broken and not excavatable without an investment of time and technique which could not be made. It is estimated that the bones of possibly 110 individuals were encountered, the burials occurring throughout the cave to the darkest recesses. However, skulls were noticeably absent.

Verbal descriptions from older residents suggest that skulls had been present in the cave around 1900 but no skulls were found *in situ* in the explorations of the cave. This suggests that skulls had been removed either by visitors or by the Maoris themselves. Support for the latter view might well come from the Maori view that the skull was the most *tapu* part of the body and therefore the first to be removed from the cave to a safer place.

In evidence given to the Maori Land Court on 25 January, 1960, a witness stated that a "line of burials" lay outside the cave. These he described as "bones of deceased persons which were placed or buried under rocks along that line." The place indicated by the witness was a line from the southern end of the burial ground to the cave. The witness stated further that there were perhaps twenty burials and that he had himself placed about twelve sets of bones in the burial cave itself some thirty or forty years previously. There is no reference to skulls being separated in any of the depositions given to the Court. The fact remains, however, that only one skull was present in the cave.

Type B. Cyst Burials.

This type of burial was discovered in 1965 and appears to be the type referred to in the 1960 evidence. The type B sites were those in which the limestone flags had been piled together to form rough cysts in which skeletons, including skulls, had been placed. One burial of type B was discovered containing in this case two skulls and two sets of long bones. No grave goods were present. There was no evidence that this cyst had been tampered with although opened cysts were found, presumably those described in the court.

Type C. Residual Category.

Type C burials were of two principal categories.

(a) burials in rock clefts on the face above the cave;

(b) a group of burials in the bush area in what may have been a collapsed cyst though there was no evidence of the deliberate piling of stones. It seems more likely that a natural cleft had been utilised in this case.

Conclusions

On the above evidence it appears likely that Ruarangi was the burial ground of a relatively small population accumulated over a period after the abandonment of Ruarangi pa site, late perhaps in the 18th century. Although many rumours of the removal of grave goods were mentioned by various interested informants, no substance could be gained for these or for the alleged sealing of a cave. It seems likely that romantic beliefs on the part of the Pakeha residents gained more credence than the evidence would support. The fact that no grave goods were recovered from untouched burials is itself consistent with what is known of Maori custom, that the

few heirlooms, greenstone ornaments and weapons, were disposed of before death and were not put with the remains.

The suggestion that great care was taken to deposit every bone must also be discounted. The untouched burials in fact contained incomplete skeletons and it seems likely that only major bones were deposited. The Maori practice of periodic re-exhumation might well account for this since minor bones would be missed or overlooked and no doubt during the period of decay, birds and rats would remove many minor bones.

The possibilities then are that the Ruarangi population was built up over a period of perhaps two or three generations of a not very numerous group — say one extended family, that of Ruangaio; or that, alternatively, it represents the dead of a larger group over a short time span. The present writer inclines to the former view for the following reasons.

(1) The pa site is in itself small presuming that its owners or their immediate descendants were the users of the burial ground.

(2) Typically a burial ground belongs to a group of the descendants reckoned from a single ancestor.

(3) A number of other burial grounds are said to have existed within a relatively short distance.

Such an interpretation accords with the view that Maori population groupings were relatively discrete, low in numerical strength, and limited to a territory of which pa, burial ground, dwelling and cultivation sites and marae were the essential nucleus.

The presence of much larger pa by the sea coast a few miles from Ruarangi suggests either numerical increase or a combination of segmentary kinship groups for common defence. The latter seems the more probable proposition considering the nature of tribal warfare about the end of the 18th and early 19th centuries.

The burial types at Ruarangi may be no more than a reflection of the nature of the ground. They may be an indication of rank differences and Maori informants held that this was so, though there is no reason to believe that any of them had witnessed traditional burials, since most, if not all, were born after 1890 when this custom had largely been suppressed by missionary endeavour. If a rank differentiation were implied then grave goods might be expected in high rank burials — as has been shown no such grave goods were found.

The problems posed by Ruarangi as a site for investigation are profound. Maori reluctance to give permission for any investigation whatever (only the Court's jurisdiction permitted an examination of the ground) and absolute prohibition on the removal of bones for examination by competent specialists set a severe limitation. Furthermore, rumours aside, Ruarangi had been frequently combed by Pakeha treasure hunters, and the worth of the cave as a site virtually destroyed.

There are indeed valuable demographic insights to be gained from a burial site when this can be shown to be related to a residential area, but in the case of Ruarangi this important data could not be gathered.

THE DENTITION OF THE MAORI DOG OF NEW ZEALAND

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Abstract. Cranial and dental characteristics of the Polynesian dog of New Zealand are defined. Pathological and congenital abnormalities are discussed, and the study is shown to be relevant to wider problems of New Zealand prehistory.

The material in this paper is based on an analysis of the dentition of 389 mandibles and 204 crania from a total of 90 sites, ranging from Stewart Island in the extreme south of New Zealand, to Tom Bowling Bay at the extreme north of the North Island (Figs. 1-2). The study was undertaken with two major aims in view: firstly to define and describe physical features of the now extinct Polynesian dog of New Zealand; and secondly to relate the data to more general archaeological problems. Since the dog, the only domesticated animal of the Maori, lived in close association with man throughout New Zealand prehistory, changes in its dentition and skeletal characteristics over time and space could be expected to give valuable indirect evidence on greater changes in Maori economy as a whole.

Abnormalities, both congenital and pathological, were carefully noted; the former because of the possible significance of their distribution over space and time, the latter for the information they might give on the age, diet, and general condition of the Maori dog.

An important point was possible variation over space or time. Although obviously the location of all skeletal material was known, it was found to be impossible to place most of the skeletal material in chronological order. Even in the few sites with radiocarbon dates (10 out of 90 sites, or 11%), skeletal material had usually not been collected according to layer. Since nearly all the sites had multiple occupation layers, covering up to 500 years[1], any time control had been lost.

Sites were therefore simply classified as North or South Island Archaic or Classic, wherever this was possible. A site was considered to be Archaic if it contained moa bones or Archaic artifacts, Classic if it contained artifacts typical of the Classic Phase. Twenty percent of the sites had no associated artifacts and could not therefore be assigned to either category, but these contained only 7% of the minimum number of dogs, and 3% of the total number of bones. Usually skeletal remains from this type of site consisted of a single cranium or mandible, which were nearly always surface finds.

[1] e.g. Pounawea, with dates ranging from 1140 ± 60 A.D. to 1660 ± 60 A.D.

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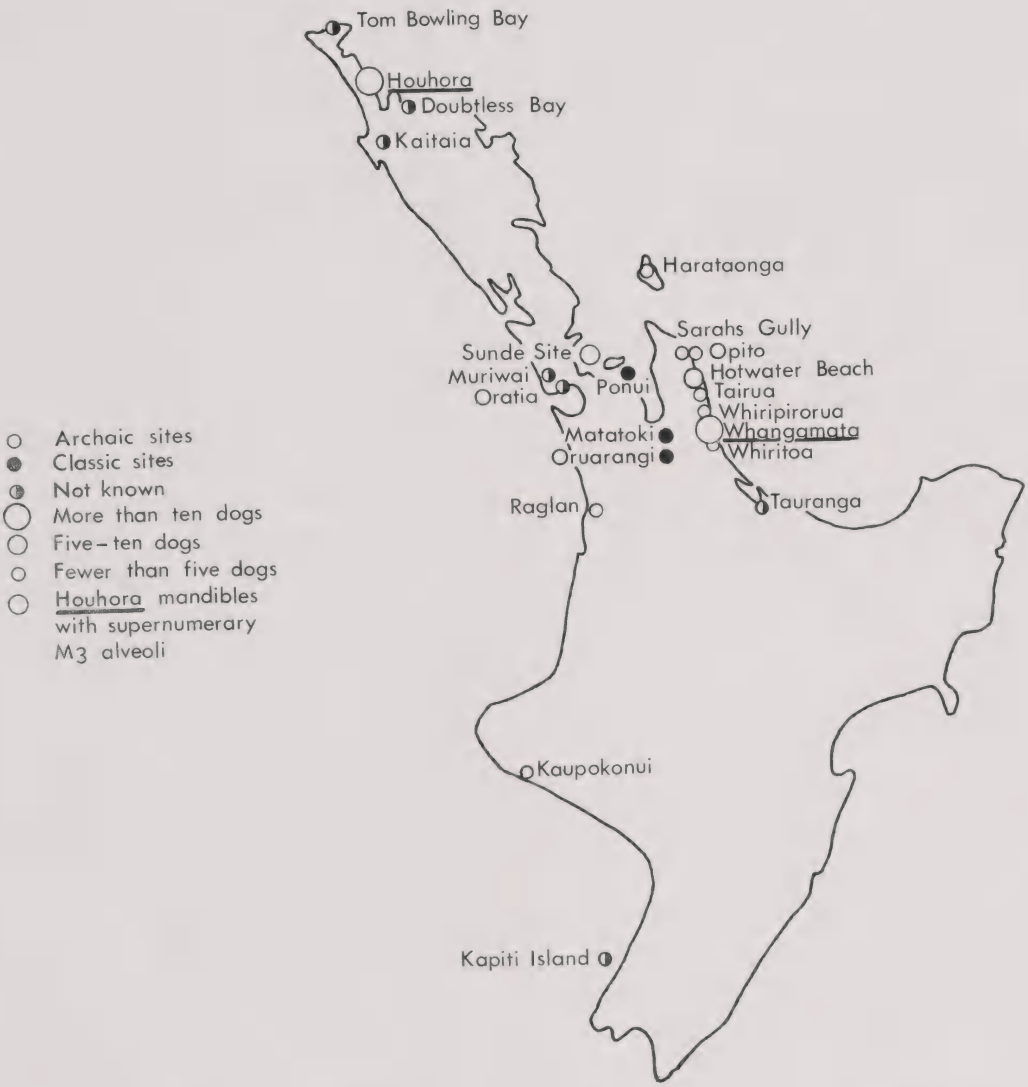

Fig. 1. Distribution of dog skeletal material studied from the North Island.

The majority of the skeletal material, then, did have cultural associations, and could thus be related to broader problems in New Zealand prehistory, as well as defining on an objective basis the Maori dog, known previously only by scattered and somewhat contradictory ethnographic descriptions (e.g. Colenso 1878; Forster 1777, p. 219; Crozet 1891; Dieffenbach 1843).

Skeletal Characteristics

It is of obvious interest to define characteristics by which Maori dog skeletal remains, often found without artifactual associations, can be distinguished from introduced European breeds. Although it was not possible to establish any feature common to all Maori dogs and unique to them, there were found to be a number

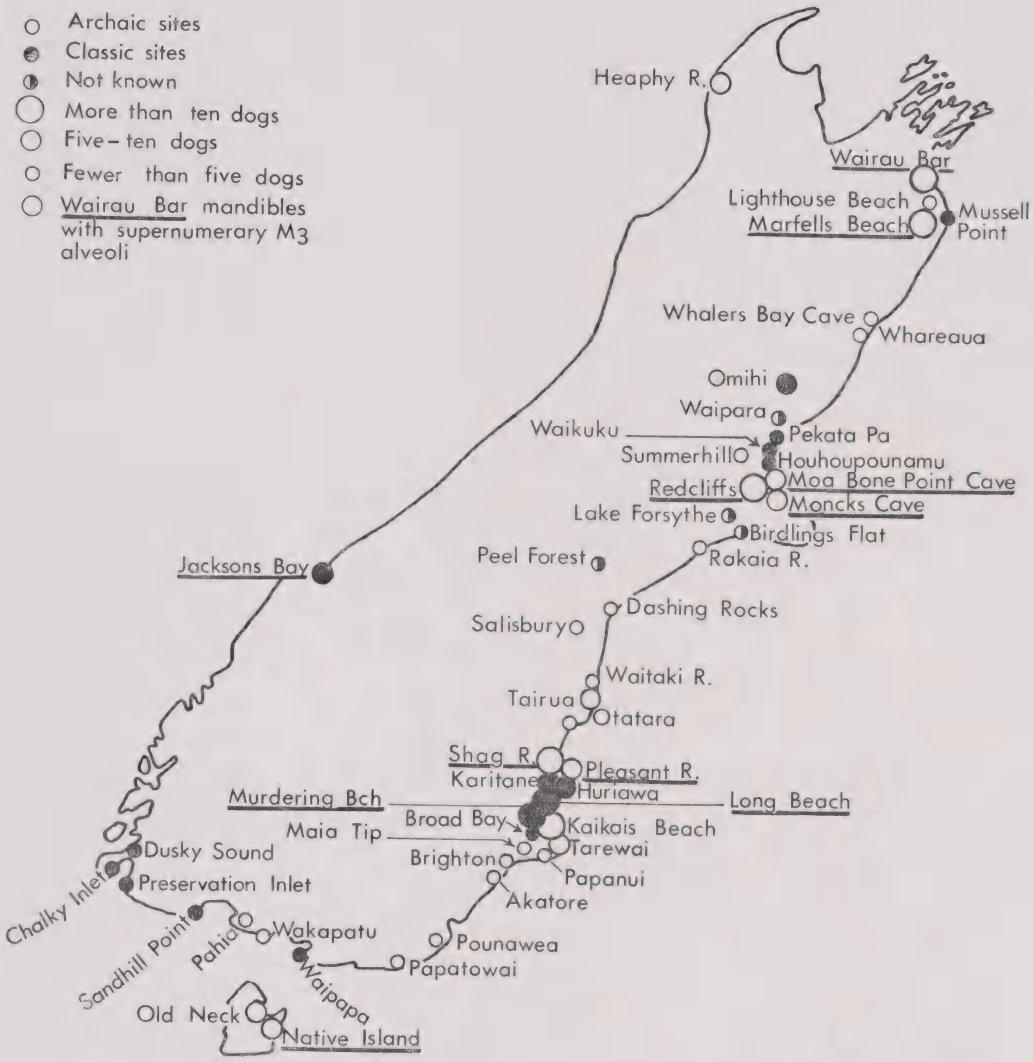

Fig. 2. Distribution of dog skeletal material studied from the South Island.

of characteristics which occur singly in many European breeds, but which are unlikely to occur together in any but a New Zealand Polynesian dog. Four of these may be established by direct observation.

Firstly, the sagittal crest is prominent. This was an almost universal feature of the Maori dog and was observed in 106 out of 110 crania or 96%[1]. However, four adult crania were found with a reduced sagittal crest, giving the back of the skull a rounded, juvenile appearance. Two of these, from Hawkes Bay and Matatoki, were surface finds, and a third comes from a site (Oruarangi) with early

[1] A large proportion of the crania lacked the posterior part, which had been removed for the extraction of the brain. The number of crania above is not the total number present in the skeletal material, but the number where the sagittal crest was present for observation.

European material; they may therefore be European dogs, or of mixed Maori-European breed. The fourth comes from a South Island Archaic site (Shag River), but its archaeological associations are unknown, and it may belong to a European breed. This cranium is unusual in other respects (see below p. 34) and, if prehistoric, may be congenitally abnormal.

The presence of a prominent sagittal crest, although characteristic of the Maori dog, is of course not unique to it, being found in any breed of dog with massive jaws and powerful jaw musculature. It is interesting to note that the features does not seem to be present in the Polynesian dogs of the Pacific Islands, which ate mainly a soft vegetable diet.

The skull of the Tahitian dog is described by Luomala (MS.) as "slender and delicate in appearance", implying a small sagittal crest, although this is not specifically mentioned.

Wood-Jones, in describing skulls of the Hawaiian native dog, stated that, consequent to a diet of soft vegetable matter, the skulls became shorter, rounder, and devoid of sagittal crests (Wood-Jones 1931). Thus the prominent sagittal crest of the Maori dog would seem to indicate a diet of hard matter, certainly bones, and possibly fern-root (Allo 1970, pp. 189-191).

Another characteristic of the cranium of the Maori dog is the situation of the posterior end of the nasal bone. It ends in a relatively anterior position, level with the posterior borders of the premaxillas (Fig. 3). In contrast, the nasals of all

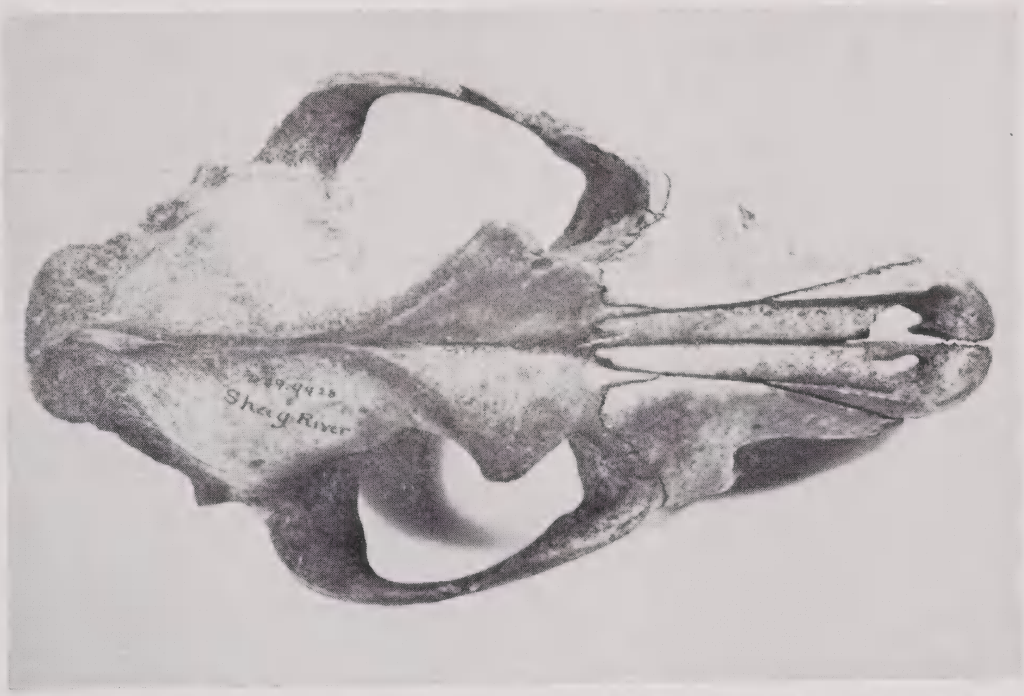

Fig. 3. Cranium from Shag River, South Island. Note position of nasal bone and pronounced sagittal crest.

observed modern breeds, both brachycephalic and dolichocephalic, end some distance behind the maxillas. This feature of the position of the nasal bone may have continued for a time in Maori-European crosses, or may be present in unobserved modern breeds, since it is also found in the Hawkes Bay, Oruarangi and Matatoki specimens mentioned above.

A third easily distinguishable feature in the crania of at least some Maori dogs is the presence of supernumerary alveoli, representing either additional teeth, or the double roots of a normally single-rooted tooth. These alveoli are usually found behind the third molar of the mandible, although sometimes they are also present between the first premolar and the canine and, more rarely, between the third and fourth premolars.

The Maori dog, as indicated below, had a dolichocephalic skull, and a very long muzzle in relation to the length of the brain-case, but this is not accompanied in European breeds by additional teeth. In his study of modern dog dentition, Crawford (1937, p. 216[1]) wrote:

> In the dolichocephalic breeds it might be expected that there would be more supernumerary teeth because of the greater length of the jaws. This has not been the case in our observations. Rather the teeth are more widely spaced with exposed gums between, especially in the premolars. The dental formula for this type apparently runs true to form.

It must be emphasised that the characteristic of additional alveoli is not a normal feature of Maori dog dentition — it was found in less than 1% of South Island mandibles — but where it is found on a site it is fairly common. It was found in 30% of the Wairau Bar mandibles, for example. The interesting question of its spatial distribution will be discussed later: here it is sufficient to note that where supernumerary alveoli are seen in a dog mandible or cranium from a New Zealand site, it is likely to be that of a Maori dog.

Fourthly, the teeth of the Maori dog are well spaced in a long narrow tooth row. Tooth crowding was very rare, being found only in one mandible (0.2% of total) and three crania (1.5% of total).

The index for tooth crowding proposed by Degerbøl (1961, p.31), whereby the combined lengths of the premolars are compared to the distance from the posterior edge of the alveolus of the canine to the anterior border of the alveolus of the carnassial, was applied to the crania from Wairau Bar, Houhora, and Whangamata. (A high figure from this indicates pronounced crowding of the teeth, while a low index indicates the opposite). Results for the crania measured were uniformly low, ranging from 75-81 (similar to the indices of free-ranging wolves, who also are characterised by a long facial region with diastema between the premolars). This is not a unique characteristic of the Maori dog, however, since tooth crowding is rare in European domesticates (except, of course, in brachycephalic and a few mesaticephalic breeds).

Finally, there are two indexes to aid identification of a cranium found in a New Zealand site as that of a Maori dog.

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[1] But cf. Sisson 1962, p. 502.

The cephalic index measures the relationship of head length to head width. The head length is usually considered to be the distance from the nuchal crest to the anterior end of the premaxillary suture; head width is the distance between the summits of the two zygomatic arches. The formula for the cephalic index is as follows:—

$$\text{Cephalic Index} = \frac{\text{Width} \times 100}{\text{Length}}$$

An extreme dolichocephalic breed, such as the greyhound, will have a cephalic index of about 50. At the other extreme is the brachycephalic pug or bull-dog with a cephalic index of about 90. Examples of mesaticephalic breeds, with a cranial index of about 70, are the fox terrier and the great dane.

A certain difficulty was experienced in establishing the average cephalic index of the Maori dog, since the combination of intact brain-case (in nearly all the crania the occiput had been detached for the extraction of the brain) and intact zygomatic arches was comparatively rare (only 6% of skulls were suitable). The cephalic index of these crania is shown in Table 1.

Table 1. Cephalic index of the Maori dog.

SITE	Cranial Width (cm)	Cranial Length (cm)	CEPHALIC INDEX
Archaic South			
Shag River	10.60	16.86	63
Shag River	10.20	18.85	54
Wairau Bar	9.75	17.65	55
Kaikais Beach[1]	7.07	13.35	53
Moa Bone Point Cave	8.55	16.72	51
Moa Bone Point Cave[2]	5.68	9.55	59
Classic South			
Karitane	9.60	17.50	55
Waipapa	8.78	15.45	57
Archaic North			
Houhora (surface find)	8.30	14.72	56
Classic North			
Matatoki	9.09	16.00	57
Oruarangi	9.08	16.46	55

[1] Juvenile, aged *c.* 7 months [2] Juvenile, aged *c.* 5-6 months

It can be seen that, although the dimensions of adult crania from different sites vary widely, the cephalic index remains relatively constant. All crania are dolichocephalic (except the Shag River cranium mentioned above) with an average cephalic index of 55, and all fall within four points of this figure. It can be accepted, then, that the Maori dog had a relatively long narrow skull, slightly broader than that of the modern greyhound.

The cranio-facial index, used to describe the shape of the face (i.e. the relative proportions of muzzle and brain-case), was also applied. This index is expressed in terms of the ratio of the distance between the nuchal crest and the fronto-nasal suture to the length of the nasal bone. Results are shown in Table 2.

Table 2. Cranio-facial index of the Maori dog.

SITE	Occiput to Nasion (cm)	Nasal Length (cm)	CRANIO-FACIAL INDEX
Archaic South			
Kaikais Beach[1]	7.53	6.08	10:8
Marfells Beach	8.55	6.93	10:8
Moa Bone Point Cave	9.02	7.78	10:8.5
Moa Bone Point Cave[2]	6.06	3.96	10:6.5
Moncks Cave	8.97	7.60	10:8
Old Neck	10.55	9.10	10:8.5
Shag River	10.46	8.65	10:8
Shag River[3]	10.60	7.57	10:7
Shag River	10.20	8.75	10:8.5
Tarewai[4]	7.48	5.46	10:7
Wairau Bar	9.14	7.55	10:8
Wairau Bar	9.81	8.18	10:8

[1] Juvenile, aged *c.* 7 months

[2] Juvenile, aged *c.* 5 months, comparatively short muzzle, crowded teeth

[3] Cranium with reduced sagittal crest, brachycephalic skull, mentioned in text

[4] Juvenile, aged *c.* 7 months

In every case there was an exceptionally high cranio-facial index, i.e. the snout was very long compared to the length of the brain-case. The cranio-facial index tends to increase with length of head. That of the greyhound, an extremely dolichocephalic breed, is only 10:7; that of the pug is 10:3. The very high cranio-facial index of the Maori dog is even more remarkable considering the characteristic anterior position of the posterior end of its nasal bone.

A long muzzle in the dog is usually associated with heavy jaw musculature and a powerful bite, hence with a diet of resistant matter requiring much crushing and grinding. It is interesting to compare the long narrow snout of the Maori dog with that of the Hawaiian dog, described as short and rounded with a short broad palate (Wood-Jones 1931). This dissimilarity is almost certainly due to dietary differences.

To summarise, the cranial and dental characteristics of the Maori dog are as follows: prominent sagittal crest; narrow skull with a very long muzzle in relation to the length of the brain-case; well spaced teeth; occasional supernumerary alveoli; and the nasal bone typically ending level with the posterior borders of the maxillas[1].

Each of these skeletal characteristics is not enough in itself to distinguish a European from a Maori dog, since each feature (with the possible exception of the position of the posterior end of the nasal bone and the supernumerary alveoli) is also found in various European breeds. They are, however, most unlikely to occur together in any but a Polynesian Maori dog. Obviously, identification of a specimen from an archaeological site as a Maori dog will increase in accuracy with the number of features available to be observed and measured.

[1] There are also characteristic features in the body skeleton, such as the long narrow glenoid fossa of the scapula, and short legs in relation to body size. See Allo 1970, chapter III.

Dogs of tropical Polynesia showed marked differences in skull and jaw formation, due to a soft vegetable diet. No dogs of this kind have been found in New Zealand, but presumably they existed, since the Maori came (with dogs) from this area. There is no way of telling how quickly the Polynesian dog in New Zealand responded physically to a new diet and environment, but certainly at least one generation would have had the broad palate and rounded skull typical of the tropical Polynesian dog. If such dogs were found on a New Zealand site, it would be strong presumptive evidence that the site represented one of the first New Zealand settlements.

Pathological and Congenital Abnormalities

PATHOLOGICAL ABNORMALITIES

Pathological abnormalities, i.e. those acquired after birth as a result of disease or trauma, were fairly common in the dentition of the Maori dog, and gave valuable information on the diet and general condition of the Maori dog.

Frequently mandibles and crania were observed with recession of the alveolar bone due to periodontal disease. This recession was sometimes accompanied by tooth loss and subsequent ossification of the empty alveolus.

Periodontal disease, an infection of the soft tissues of the mouth and subsequently of the alveolar bones, may be caused by attrition, irritation by tartar deposits, poor diet resulting in lowered tissue resistance, or sometimes irritation from a faulty or damaged tooth (see e.g. Brothwell 1963, pp. 147-149).

Table 3 gives the incidence of periodontal disease in the various sites, showing the jaws and teeth affected, the degree of tooth wear (see p. 37), the degree of alveolar recession, and the cause (where known).

Table 3. Periodical disease in the Maori dog.

SITE	JAW	TOOTH WEAR	TOOTH AFFECTED	DEGREE OF PERIODONTAL DISEASE	PROBABLE CAUSE
Archaic South					
Kaikais Beach	R. Mandible	*	P_3, P_4, M_1	Medium	Possible attrition
Little Papanui	R. Upper	3.5	P^4	Slight	
Moa Bone Pt. Cave	R. Mandible	*	P_2, P_3	Considerable	
Pleasant River	L. Mandible	2	Canine	Slight	
Shag River	L. Mandible	*	P_4	Considerable	
Wairau Bar	L. Mandible	1	P_3, P_4	Slight	
Classic South					
Huriawa	R. Upper	3.5	P^4	Slight	Possible attrition
Karitane	L. Upper	4	P^3	Slight	Attrition
Long Beach	R. Mandible	*	P_4, M_1	Slight	Irritation from congenital deformity[1]
Murdering Beach	L. Upper	*	P^3	Slight	

* Teeth fallen out after death

[1] Congenital deformity of dentition: only 2 premolars (no P_1, P_2), P_4 has two fused roots in a single alveolus

It can be seen that there is a higher rate of periodontal disease in the lower than in the upper jaws, and that it is not known in North Island sites. The fact that periodontal disease was not found at either Houhora or Whangamata, with a total of 94 mandibles, may imply that some factor causing alveolar infection was present only in the South Island. This factor may be diet: either the South Island dogs may have had a lower nutritional intake, leading to diminished tissue resistance, or their diet may have consisted of a higher proportion of resistant matter, such as bones, resulting in accelerated dental attrition, one of the causes of periodontal disease.

An examination of tooth wear in the Maori dog would seem to support the latter explanation. Obviously the rate of tooth wear in a dog would be affected by its diet. It would be expected that the teeth of an animal eating a hard resistant diet would wear more quickly than those of animals living off softer foods.

The teeth of each jaw studied were given a rating on a scale from one to five (to half a point). The rating was as follows.

1. Some abrasion on inner surface of carnassials, but very little. Incisors still have the "fleur de lys" shape.

2. Cusps on carnassials and first and second molars show signs of wear. "Fleur de lys" shape begins to disappear.

3. Carnassials very worn, partial disappearance of lingual cusps on upper first molar. Canine shows signs of wear, disappearance of "fleur de lys" shape of incisors. (In European dogs this takes place at approximately two years).

4. Cusps worn flat on second molar (also third molar in lower jaw), also posterior cusps of lower carnassial. Extensive wear on crowns of incisors, premolars.

5. Incisors worn almost flat to original gum surface, wear on canine gives spatulate flat top to crown. Inner surface of carnassials and molars worn smooth and concave. Large anterior cusps of carnassials worn completely away. (In a European dog, eating processed foods, the last stage of wear would indicate extreme old age. The same is not necessarily true of the Maori dog).

Results of application of this scale are shown in Table 4.

It is evident that the pattern of extreme tooth wear is found only in South Island sites. If the average age at death of the dogs from North and South Island sites was the same, these results would seem to indicate conclusively that North Island dogs did live off a softer vegetable diet, but since tooth wear is a product of age as well as diet, the high frequency of advanced tooth wear in, for example, the South Island Classic sites of Long Beach and Murdering Beach, may also imply a higher proportion of aged dogs. This is also suggested by other evidence (Allo 1970, pp. 117-130). It is unlikely, however, that there were no aged dogs in the North Island sample, and the differences in tooth wear are likely to be at least partly due to dietary differences.

Table 4. Tooth wear in the Maori dog.

SITE	RATE OF TOOTH WEAR									
	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Archaic South										
Heaphy River	1									
Kaikais Beach	3	3	2	3	3			1	1	1
Marfells Beach	5	3	1	5	1	1				
Pleasant River	1	5	1	2		2		1	3	1
Tai Rua			2	1						
Wairau Bar	1	12	3	7		2		1		
Classic South										
Long Beach	1	3	1	1	1		1			4
Murdering Beach		2		1	1	2	1		1	8
Archaic North										
Houhora	2	2		1	1	3	1	2		
Whangamata	2	1	1	1	1	2				
Classic North										
Houhora		1		2	1		1	1		

Another abnormality in dentition relating to diet which was particularly common in dogs of the South Island was the loss of a tooth during life, with subsequent ossification of the alveolus. This was due in one case to periodontal disease; otherwise it was probably due to trauma (accidental injury). Table 5 shows the distribution of jaws with premortem tooth loss, and the teeth involved.

Table 5. Premortem tooth loss in the Maori dog.

SITE	JAW	TOOTH LOST
Archaic South		
Akatore	Left mandible	P_4
Pahia	Left mandible	P_4
Shag River	Left mandible	P_4
	Left mandible	P_4*
Wairau Bar	Left mandible	Canine
	Right mandible	Canine
Classic South		
Karitane	Right maxilla	I^1
	Left mandible	P_1
Archaic North		
Opito	Right mandible	P_4

* Due to periodontal disease, see Table 3

Tooth loss during life was found in lower rather than upper jaws and was more common, according to both absolute number and percentage of the number of mandibles in each major grouping, in South Island than in North Island sites (Table 6), although in no site was it common.

Table 6. Relative incidence of premortem tooth loss.

SITE	NUMBER OF MANDIBLES WITH TOOTH LOSS	PERCENTAGE OF TOTAL NUMBER OF MANDIBLES
Archaic South	6	3.4%
Classic South	1	2.0%
Archaic North	1	1.0%
Classic North	0	0.0%

It can be seen that the only teeth lost before death are those in the anterior part of the jaw — the incisors, canines and premolars. Whereas molars are used for grinding down food, the anterior teeth are used for tearing or shearing food off (St. Clair & Jones 1957). The latter are, therefore, especially subject to accidental injury, and the presence of such injuries could be related to a hard resistant diet, such as bones.

The small number of jaws involved would make generalisations based on premortem tooth loss absurd. However, the evidence supports the other indications of dietary differences between the dogs of the North and South Islands; that the dogs of the North Island, during both Archaic and Classic Phases, ate a larger proportion of soft vegetable foods than those of the South Island. That this was not an exclusive dependence, however, is indicated both from the wide range of fauna in the middens of both periods (eaten by the Maori, and presumably therefore also by his dog) and by the almost complete absence of dental caries in the Polynesian dog of New Zealand.

Svihla, in the only detailed study of the dentition of the tropical Polynesian dog, found that dental caries in the dog were comparatively common during the prehistoric period in Hawaii (Svihla 1957, p. 11).

> The marked prevalence of caries in the teeth of the native Hawaiian dogs . . . may have been due to their diet, which was rich in starches and sugars. Although the digestion of starch takes place principally in the small intestine, even minute amounts lodged in the teeth may be converted by enzymatic action into sugars and thus serve as centres of corrosion and caries formation.

Caries were found in eleven of the thirty pre-European mandibles studied (37%) and in five of twenty-one upper jaws (24%). Usually more than one tooth was affected, and especially the first and second molars. Svihla (1957, p. 12) added that, with the introduction of European food animals into Hawaii, the diet of the Hawaiian people has changed, and now incorporates large amounts of pork and beef.

> This, in turn, means that the dogs now have a greater amount of meat in their diet. Perhaps this explains why the teeth of modern dog skulls in the Museum's collections have no caries.

Only two cases of caries were found in the Polynesian dogs of New Zealand. One of these, from Wairau Bar, is associated with, and is almost certainly the result of, congenital dental abnormality. The right carnassial of the affected skull is impacted into the first molar and both teeth show an abnormal pattern of wear (the surface of the molar acted as a shearing rather than as a grinding surface and has been pushed outwards by pressure from the first molar of the mandible). Extensive dental caries, involving almost half the tooth, and associated abscessing, affected the impacted carnassial (Fig. 4). The only other case of caries, found in the first and second molars of a mandible from Houhora, is not associated with congenital or pathological abnormality.

Two other cases of abscessing were found in the Maori dog, both from South Island Archaic sites. In the first case, from Shag River, involving the first molar of an upper jaw, the infection was comparatively minor. The second case, found

Fig. 4. Cranium from Wairau Bar with impacted carnassial and consequent dental caries and abscessing.

in a right mandible from Redcliffs, was much more severe and was of long standing. The mandible had a pronounced swelling on the lower edge of the horizontal ramus. Most of the teeth were still in place in the jaw; however, an X-ray revealed pronounced abscessing on both roots of the carnassial and, to a lesser extent, at the roots of the second and third premolars. That the abscess is chronic is shown not only by the swelling on the ramus, but (apparent in the X-ray) by the reactive scelerosis of the bone surrounding the infection.

CONGENITAL ABNORMALITIES

It has already been noted that one of the most characteristic features of the Maori dog is the presence of supernumerary teeth, which, although not found in all Maori dogs, does seem to be particular to them. Altogether there were found thirteen types of congenital dental abnormality, most of which were located in both upper and lower jaws. They were as follows.

Mandible

1. Double rooted P_1 (usually P_1 has a single root).

2. Absence of P_1 (only three premolars were present).

3. Presence of five premolars (P_1 and P_2 were single rooted, the remainder were normal).

4. Single rooted P_3 (usualy P_3 has two roots).

5. Single rooted P_4 (usually P_4 has two roots).

6. Fusion of the two roots of P_4 into a single tooth root (shaped like the figure 8).

7. Fusion of the two roots of M_2 into a single tooth root (shaped like the figure 8).

8. Absence of M_3. Since M_3 is the last tooth in the jaw to erupt, this is a normal feature in mandibles aged 6-7 months, and was considered a dental abnormality only when accompanied by pronounced tooth wear.

9.i) Double rooted M_3 (usually M_3 has a single root).

ii) Presence of small single rooted M_4.

Since in most cases the teeth had fallen out after death leaving empty alveoli it was often difficult to distinguish between these two features; they were therefore treated as one.

10. Impacted P_1 (in all observed cases with the tooth angled towards the canine).

Cranium

1. Double rooted P^1 (usually P^1 has a single root).

2. Absence of P^1.

3. Presence of five premolars (first two premolars are single rooted, the remainder are normal).

4. Presence of small single rooted premolar between P^3 and P^4 (very rare).

5. Impacted P^1 (with the tooth angled toward the canine).

6. Impacted P^2 (in all observed cases with the tooth impacted towards the molars).

7. Impacted P^4.

Tables 7 and 8 show the incidence of dental abnormalities in the various sites of the North and South Islands. It can be seen that supernumerary alveoli are by far the most common form of dental abnormality, and that these were usually found at either end of the series of cheek teeth, and in particular behind the last molar.

It is evident that abnormalities in the mandible were greater in both number and extent than those in the upper jaws. The proportion of mandibles with supernumerary alveoli, compared with the total number of mandibles, in the different groups of sites, was as follows.

Archaic South	17[1]	(0.9%)
Classic South	8	(17%)
Archaic North	8	(7%)
Classic North	2	(13%)

[1] One Marfells Beach mandible had both additional molar and premolar.

Table 7. Congenital dental abnormalities in Maori dog mandibles.

SITE	TYPE OF ABNORMALITY (see key below)									
	1	2	3	4	5	6	7	8	9	10
Archaic South										
Marfells Beach	2 (10%)						1 (5%)	1 (5%)	2 (10%)	
Moncks Cave							2 (33%)			
Moa Bone Pt. Cave									1 (10%)	
Redcliffs							2 (25%)		3 (38%)	
Native Island									1 (50%)	
Pleasant River									2 (13%)	
Shag River	1 (4%)						1 (4%)	2 (8%)	1 (4%)	1 (4%)
Tai Rua	1 (6%)									
Wairau Bar			2 (10%)						2 (10%)	2 (10%)
Classic South										
Jacksons Bay									3 (43%)	
Long Beach						1 (6%)	2 (13%)	1 (6%)	3 (19%)	
Houhoupounamu									1 (20%)	
Murdering Beach							1 (17%)		1 (17%)	
Archaic North										
Houhora	1 (3%)			1 (3%)					2 (5%)	
Whangamata					1 (2%)		1 (2%)		2 (5%)	
Sarahs Gully	1 (50%)									
Sunde Site							1 (50%)			
Classic North										
Houhora									2 (12%)	

KEY

1. Supernumerary P_1 tooth root
2. Absence of P_1
3. Supernumerary single rooted premolar
4. Single rooted P_3
5. Single rooted P_4
6. Root fusion P_4
7. Root fusion M_2
8. Absence of M_3
9. Supernumerary M_3 tooth root
10. Impacted P_1

Table 8. Congenital dental abnormalities in Maori dog crania.

SITE	TYPE OF ABNORMALITY (see key below)						
	1	2	3	4	5	6	7
Archaic South							
Kaikais Beach	1 (25%)						
Old Neck		1 (17%)	1 (17%)				
Native Island	1 (50%)						
Shag River	2 (25%)			2 (25%)			
Wairau Bar						1 (8%)	1 (8%)
Classic South							
Long Beach	1 (17%)						
Murdering Beach	1 (7%)						
Archaic North							
Houhora	1 (4%)						
Tairua					1 (50%)		
Sunde Site	1 (100%)						

KEY

1. Supernumerary alveolus (P^1)
2. Absence of P^1
3. Supernumerary premolar (single root)
4. Supernumerary alveolus (between P^3 and P^4)
5. Impacted P^1
6. Impacted P^2
7. Impacted P^3

There is apparently a higher incidence of congenital dental abnormality in mandibles from Classic sites, although this tendency is not seen in dental abnormalities in the crania.

An interesting fact emerges, however, if we compare the percentage of dental abnormalities in each site with the overall percentage. Where jaws with supernumerary alveoli are present in a site, they are present in relatively high proportions: in nearly every case over 30% of the mandibles are abnormal, and the proportion may reach 60% (e.g. at the Redcliffs site). The low overall proportions are due to the fact that congenital dental abnormalities are completely absent from most sites.

The reason for this is obvious: such characteristics are inherited, and if the progenitor of a population of dogs included in its dentition a dental abnormality, this would be likely to be seen in its descendants. This would not be true if the characteristic were unfavourable, but supernumerary teeth in the Maori dog were not associated with tooth crowding or infection which would result in an impaired bite and hence reduce chances of survival.

If the distribution of sites with mandibles possessing a supernumerary M_3 alveolus, the most common abnormality, is studied, it is found that they tend to fall into clusters isolated in both time and space (Figs. 1-2). The Archaic sites of Wairau Bar and Marfells Beach possess this feature; the nearby Classic site of Mussel Point does not. Similarly it is present in the Classic sites of Murdering Beach and Long Beach, but missing in the group of Archaic sites in the south.

It has been indicated in both ethnographic and archaeological evidence that the Maori engaged in seasonal cycles of activity involving transhumance within a

limited locality (e.g. Firth 1959; Green 1963; Shawcross 1967). Obviously this movement would also involve dogs and it would, therefore, be expected that a characteristic abnormality would not be confined to a single site, but distributed among an associated cluster of sites. Because of the lack of detailed time control, contiguous sites cannot definitely be established as contemporaneous and their association with Archaic or Classic traits simply limits them to an approximate 500-year period. Thus a definite economic relationship, between sites within the cluster where a specific dental abnormality occurs, cannot be shown. It can be stated, however, that the presence of such an abnormality in the dog skeletal remains of two contiguous sites implies some sort of economic relationship, while its presence in one site but absence in the other would make such a relationship unlikely.

CONCLUSIONS

A study of the dentition of the Maori dog provided two types of information — firstly descriptive, how a Maori dog may be recognised and distinguished from other breeds; and secondly, indirect evidence on Maori economy as a whole. Thus the distribution of dental abnormalities into clusters isolated both spatially and temporally would seem to imply some kind of economic relationship among these sites. Of great importance is the fact that although there are significant differences in dentition (tooth wear, incidence of periodontal disease and premortem tooth loss) between North and South Island sites, there are no such differences between Archaic and Classic sites in the North Island. The evidence would seem to indicate that dogs of the North Island, during both Archaic and Classic Phases, included an appreciable amount of vegetable food in their diet. Since the Maori dog presumably shared the diet of its master, it would seem that some dependence on vegetable foods was not unique to the North Island Classic economy, but was a feature also of the Archaic Phase.

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ANTHROPOMORPHIC STONE POUNDERS IN NEW ZEALAND

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Abstract. Stone flax pounders from different areas are compared to suggest a pattern of distribution and a derivation of one particular group commonly known as "Taranaki" pounders.

New Zealand pounders or beaters, whether in stone, wood or bone all seem to share one characteristic which sets them apart from all others in Polynesia: they are nearly all side pounders rather than tip pounders. In Polynesia, where pounders are employed principally for food preparation, they are used with a motion that places the tip or striking surface parallel with the palm of the hand but separated from it by the body of the pounder which is held at a right angle to the palm. In New Zealand, a pounder is held parallel with the palm of the hand by grasping the handle. The striking surface, which is a side about one-third of the distance from the tip, is parallel with the palm but forward of it by the length of the pounder between the hand and striking surface.

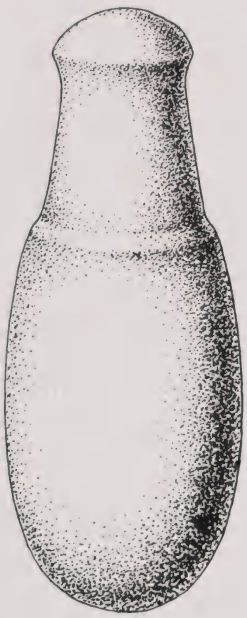

Fig. 1. A.M. 30841 Loc. probably Northland. Polished basalt. Length 25cm. Gift E. E. Vaile.

Rec. Auckland Inst. Mus. 8: 47-55 December 17th 1971

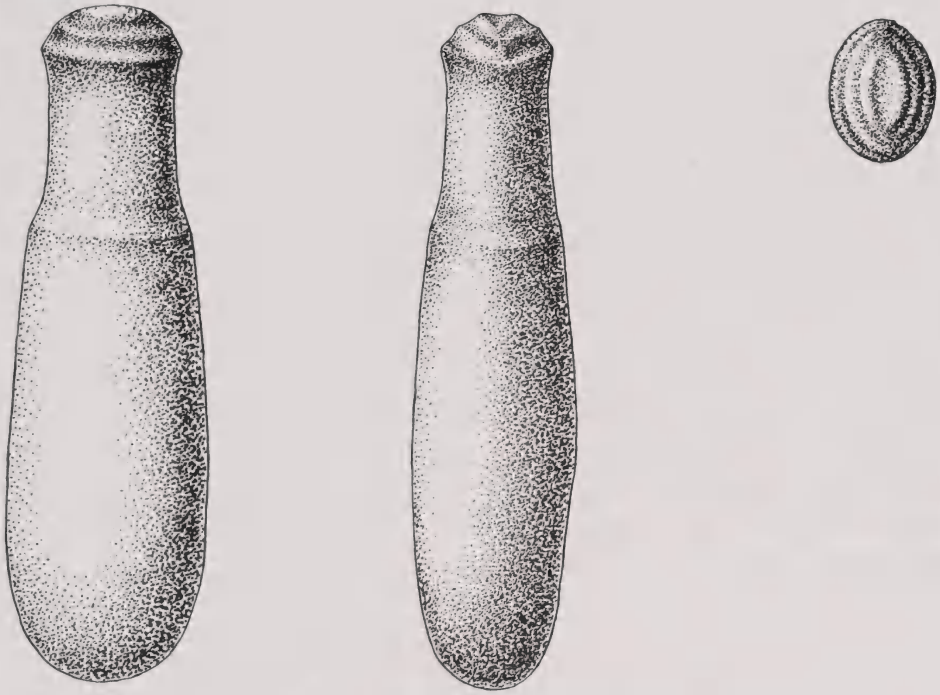

Fig. 2. A.M. 31075 Loc. Waiuku, Manukau Harbour. Polished basalt. Length 26.5cm. Gift J. Arkle.

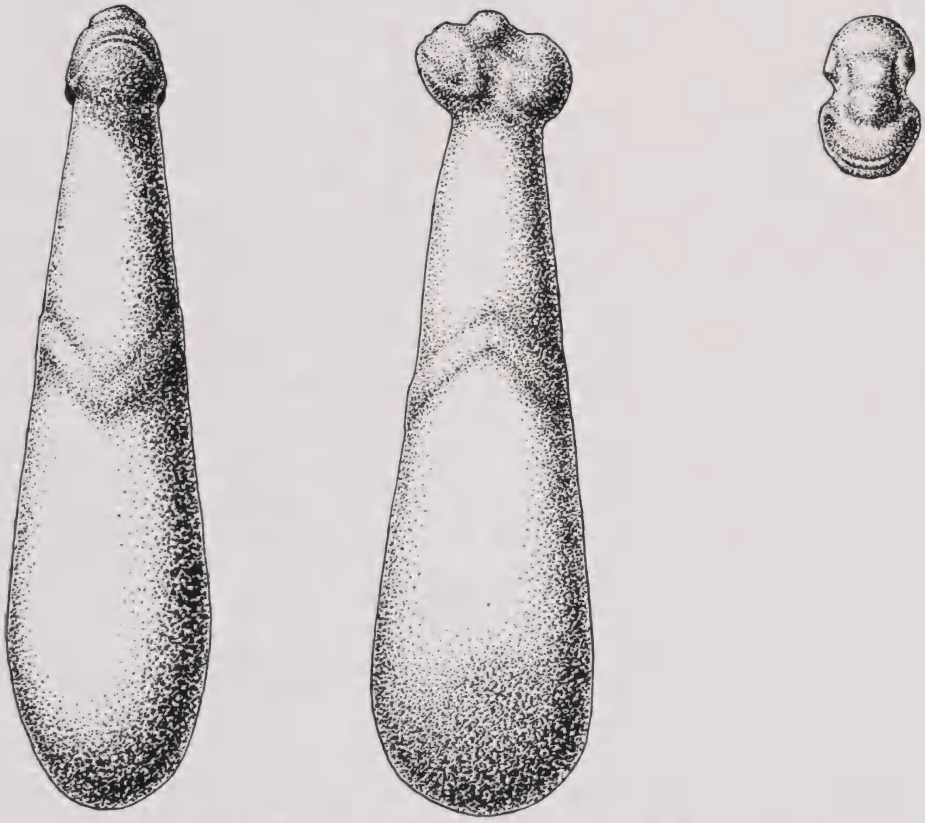

Fig. 3. A.M.20091 Loc. Taranaki. Fine andesite. Length 30.5cm. Vaile Collection.

Pounders or beaters of this latter type were used in New Zealand for a number of different purposes. Wooden ones were utilized for beating the fibre from fern root *(Pteridium esculentum)* or for preparing other vegetable foods. Specialized wood, or more commonly bone examples were used as mallets for wood carving, or longer wooden examples as simple mallets for driving in stakes in such constructions as eel weirs. Stone examples were also used or made for these purposes either as simple pebbles, or roughly or finely worked into beaters, pounders or mallets.

One particular group of stone pounders was used to soften the fibre of flax *(Phormium tenax)* in preparation for the finger weaving of cloaks or other textile items. This style of weaving is a local evolution in New Zealand made necessary by demands of a temperate climate (see Te Rangi Hiroa 1926). The two associated tools, the flax pounder and weaving stick, were also local developments (Te Rangi Hiroa 1950, p. 168). The stone pounders *(patu muka)* were used to beat the hanks of prepared flax fibre on a flat stone.

The commonest and most widely distributed forms of stone pounder are round in section with a rounded end, a reduced hand grip and a rounded butt sometimes ornamented with grooves similar to those on the butt of a fighting club *(patu onewa)*. One variety is very bulbous (Fig. 1) and is fairly common in Northland, central North Island and more rarely in North Taranaki the East Coast and the South Island, while a second variety, less bulbous and often parallel sided (Fig. 2) is found in Northland, Auckland, Bay of Plenty and East Coast areas. The distribution of these two main varieties tends to be complementary but is not exclusive.

A third variety has a rounded butt overhanging the base of the handle. From this point to the striking edge the diameter of the club increases gradually with no clearly defined shoulder at the junction of the handle and body. This variety of pounder is often furnished with anthropomorphic features on the butt, panelling or chevrons on the body. In some instances the body is covered with spiral or other designs. A pounder with elaborate designs over the whole body was probably associated with some form of ceremonial function.

Simple pounders of this variety without special features are found mainly in Northland and Taranaki. The anthropomorphic forms have so far been recognized as "Taranaki" pounders. Their distribution is so regional, in fact, that the occurrence of this variety outside Taranaki has often been questioned by curators when cataloguing collections. The occurrence of a fine-grained andesite from Mt Egmont in the area between Omata and Inglewood in North Taranaki could be accepted as an explanation of the abundance of pounders in that area and trade invoked for the subsequent distribution within the area. This could explain the occurrence but not the elaboration.

The Anthropomorphic Pounder

The characteristics of the anthropomorphic yet still practical Taranaki pounder are shown in Fig. 3. In Taranaki Museum, New Plymouth, are many very elaborate and beautifully made specimens (Fig. 4). The fairly simple form is the one being considered here.

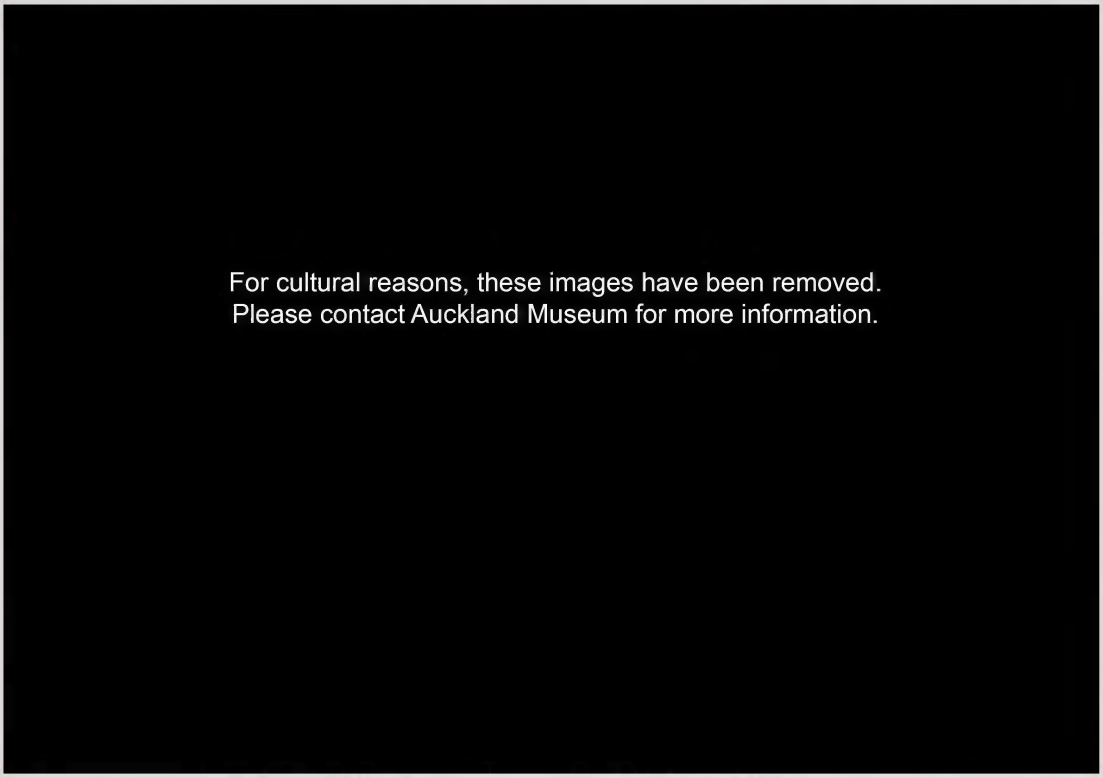

Fig. 4. Anthropomorphic pounders in Taranaki Museum.

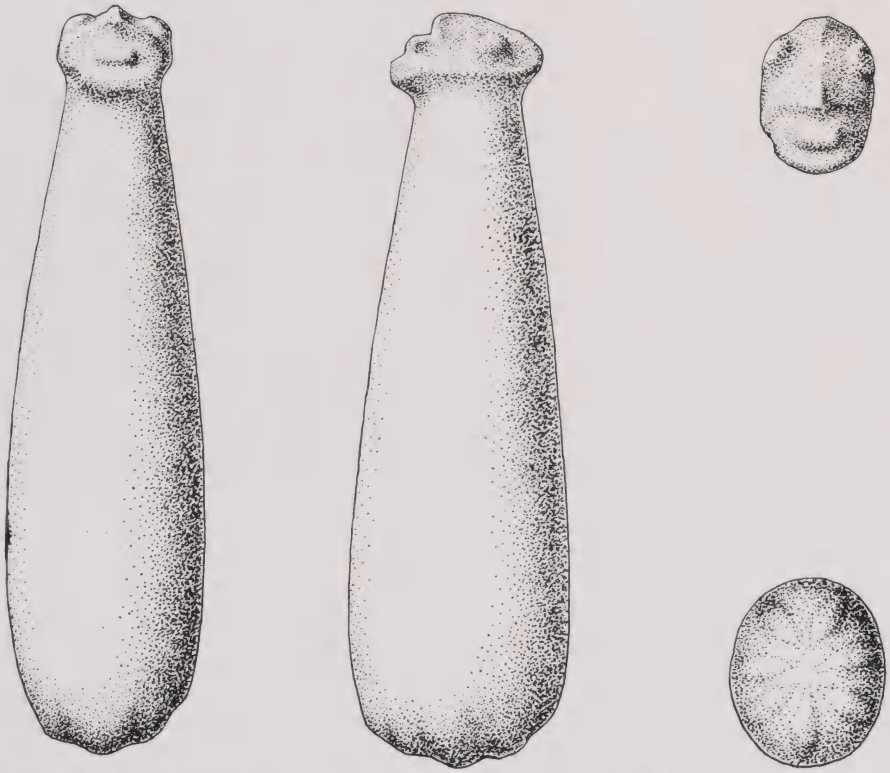

Fig. 5. A.M. 7984 Loc. unknown. Fine andesite, possibly of Taranaki origin. Length 30cm. Ex Tod Collection, Rotorua.

This simple form has a head on the butt facing away from the pounder, and may have chevrons on the shoulder and raised lines separating the body of the pounder into panels. These latter are sometimes ground flat to give almost a four or five-sided cross section to the body. Fig. 3 has a fairly small head on the butt; in some pounders this feature is quite big, with spiral eye forms and other facial elaboration.

Fig. 5 has no locality but came from a collection in Rotorua. The form of the head on the butt is unlike those of Taranaki. In profile the outline of the face is curved and is really eyes and mouth added to the central nose line on which the face is based. The rest of this pounder is unadorned except for the tip which has been divided into a roseate pattern with incised grooves.

Fig. 6 was found on Waikaraka Beach, Onehunga, on the Manukau Harbour at Auckland. The stone appears to be a local andesite. The head on the butt parallels very closely the head on Fig. 5. At the shoulder point there are chevrons with raised lines leading from each angle down the body of the pounder. In this example "typical" Taranaki features are allied with a head form very different from those in Taranaki.

Fig. 7 is from Kawakawa in the Bay of Islands. The head on the butt in the proportions of mouth width to forehead width has a resemblance to the Taranaki butt faces. A similar head is found on a wooden pounder from Waipu in the Frazer Collection in Auckland Museum.

Fig. 8 is also from Kawakawa in the Bay of Islands. It has a head on the butt with prominent circular eyes, a rounded mouth with parted lips and forehead knob. The shoulders are ornamented with a chevron on each side. These features would appear to be somewhat crudely done but otherwise unremarkable if it were not for the carefully notched vertebrae shown on the back of the handle connecting the butt head and chevrons which are in reality the arms of the figure. The pounder itself is a human figure. This pounder suggests that the origin of the special features of the Taranaki and the Onehunga pounders are simplified from a total human concept as illustrated in this pounder. The form of the head used on the butt suggests Polynesian parallels and would appear to be ancient. It is interesting to note that a simplified form consisting of circular protuberances and the forehead knob is found on the butt of a Duff type 1A adze (Duff 1959) found at Turangi in the central North Island. (This adze is in the Tongariro Information Centre.)

In Taranaki the chevrons occur but no antecedents for them have so far been seen. In the Kawakawa pounder the antecedents are present in the form of arms on a human figure. A reflection of these antecedents is seen in Fig. 9 a Taranaki pounder with circular collar elaborated into hands on the "belly" of the pounder, and in Fig. 10 where one specimen has a row of square notches on the "spine".

Fig. 11 illustrates the common form of late bulbous pounder. This specimen was in the possession of Te Horeta of the Bay of Islands until given to Dr Lee in 1874. It is unusual in having the butt elaborated into a face, showing that even in the late period the anthropomorphic association of these pounders was not entirely forgotten, though they were more normally ornamented, if ornamented at all, with the ridged butt borrowed from the *patu onewa* club.

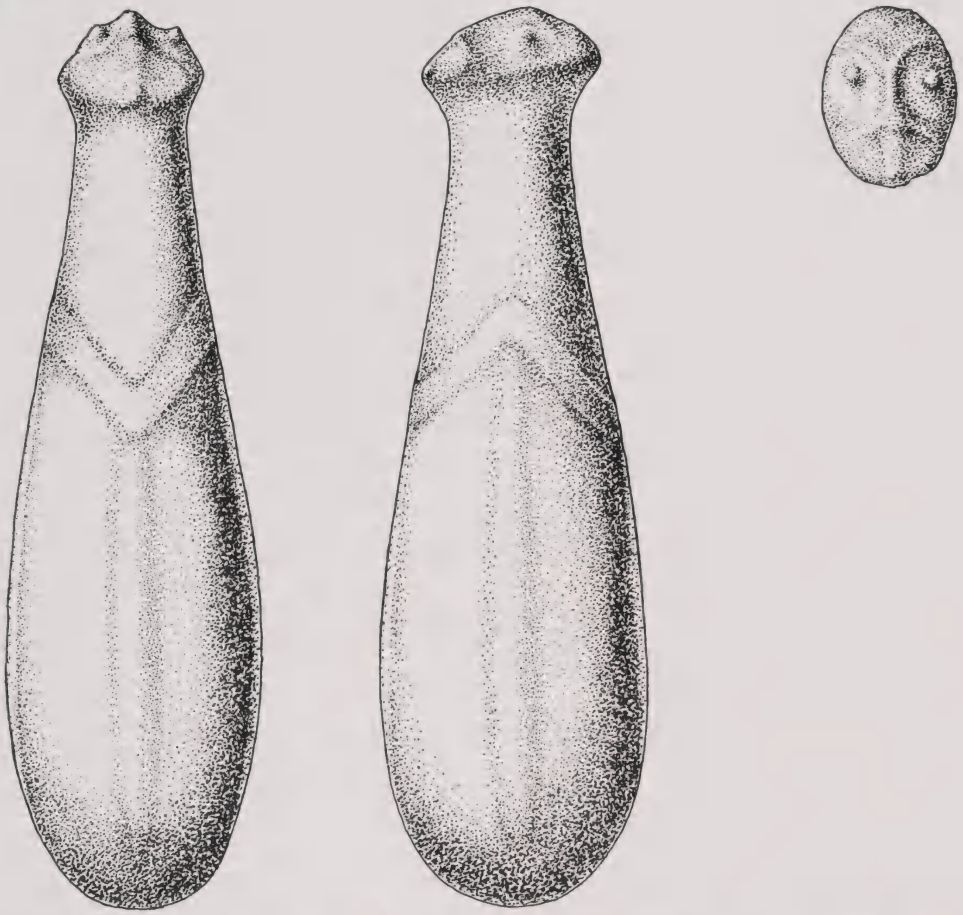

Fig. 6. A.M. 20266 Loc. Waikaraka Beach, Onehunga. Local andesite with small black crystals. Length 35cm. Gift W. C. Hill.

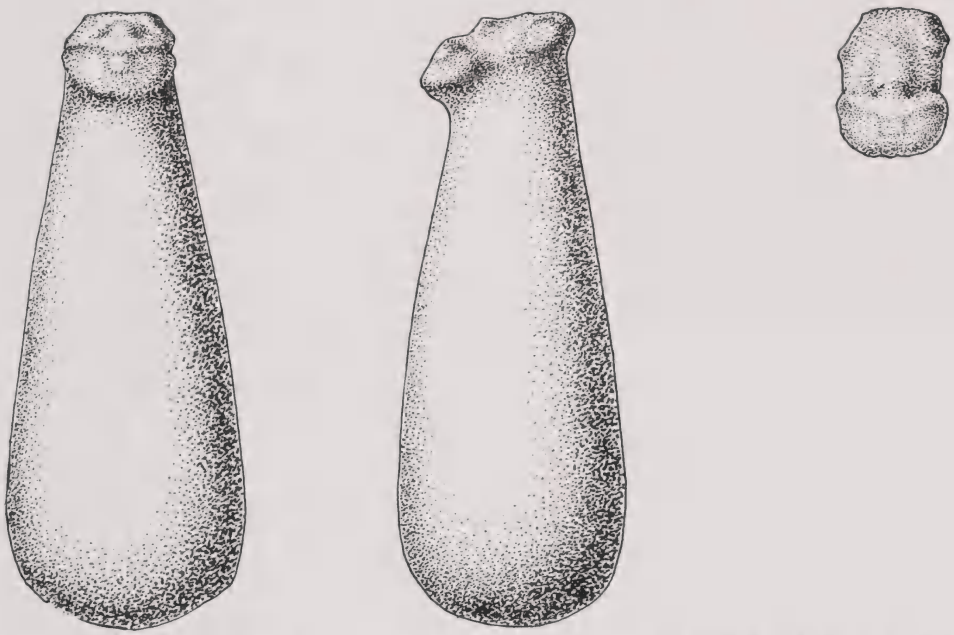

Fig. 7. A.M. 5056 Loc. Kawakawa, Bay of Islands. Local andesite with large black crystals. Length 23.5cm. Gift G. Graham.

Fig. 8. A.M. 5057 Loc. Kawakawa. Local andesite. Length 28cm. Gift G. Graham.

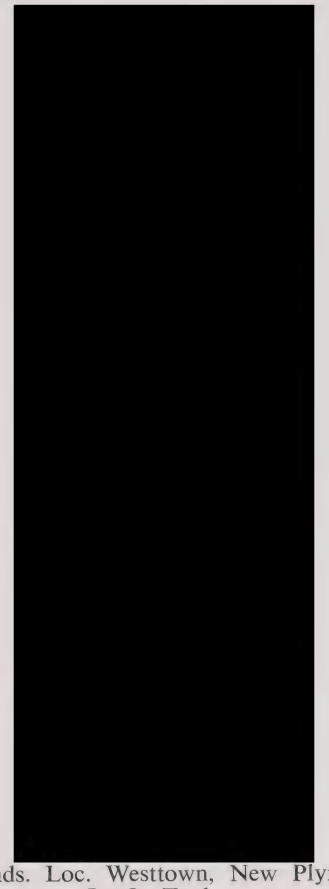

Fig. 9. Pounder with hands. Loc. Westtown, New Plymouth. Taranaki Museum, L. O. Taylor.

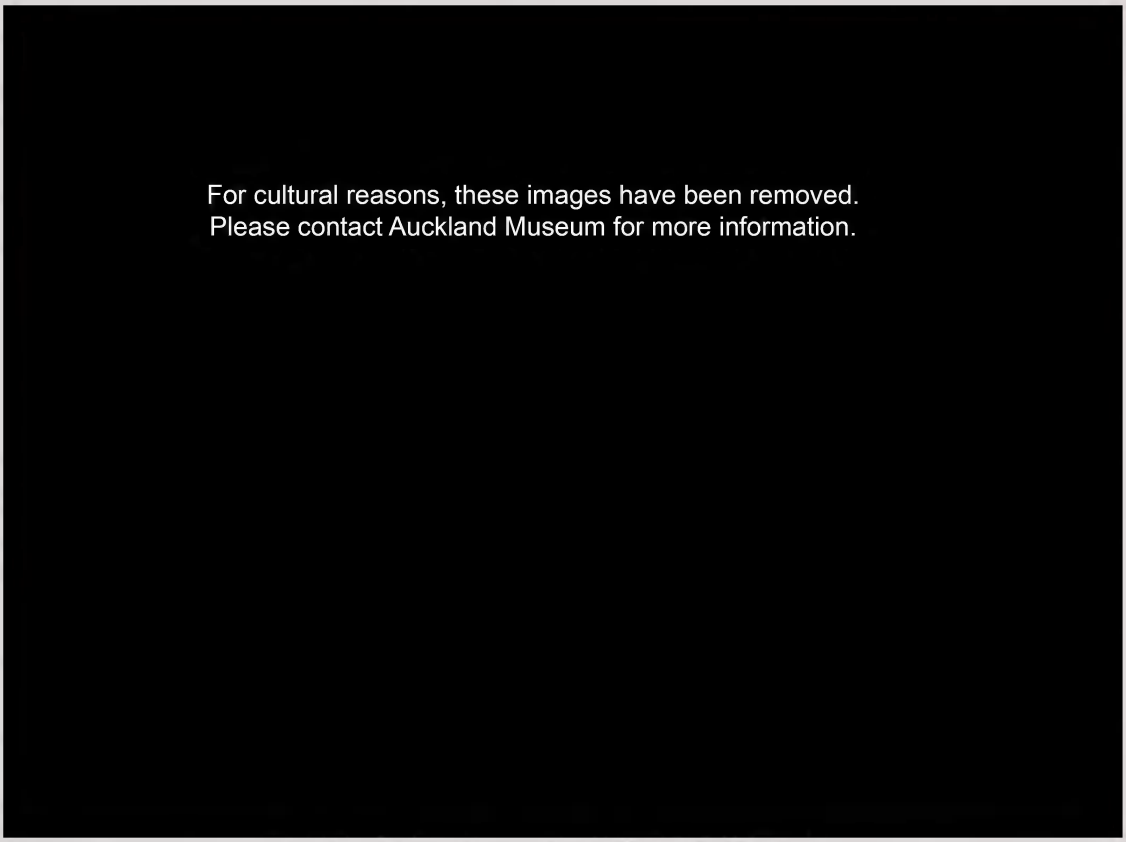

Fig. 10. Elaborate pounders in Taranaki Museum.

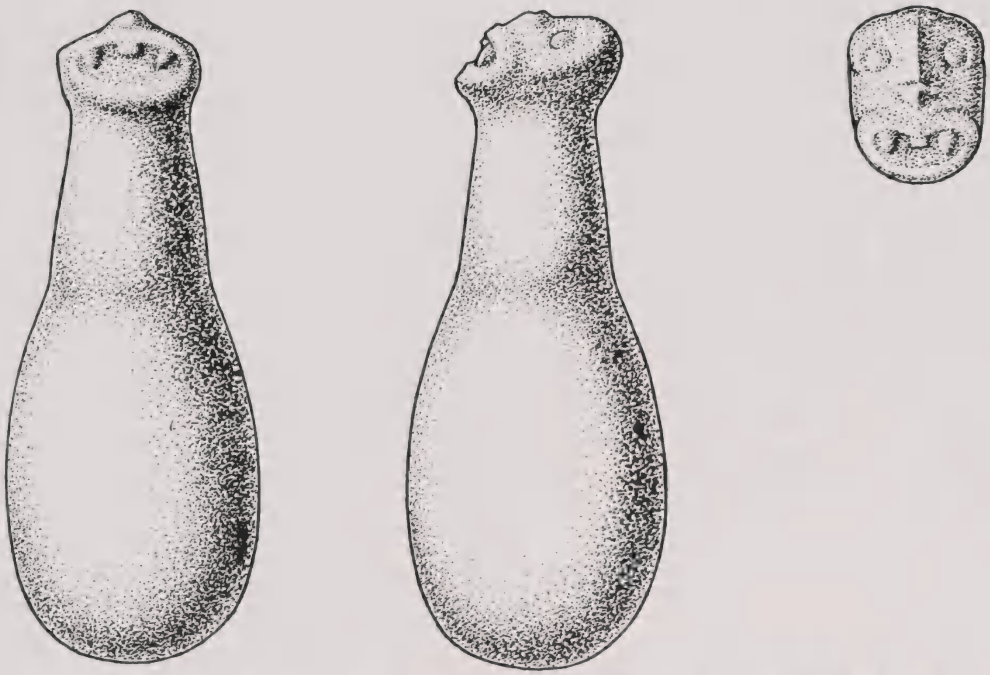

Fig. 11. A.M. 475 Loc. Bay of Islands. Andesite. Length 24cm. Gift Dr A. Lee.

CONCLUSION

It is suggested that the antecedents of the elaborate Taranaki variety of flax pounder is to be found in a completely anthropomorphic shape as illustrated in the pounder from Kawakawa (Fig. 8).

The occurrence of a similar pounder made from local stone at Auckland and possibly from the central North Island or North Taranaki, suggests a line of connection between the two areas. The differences in the carving of the heads on the butts would also suggest that the Kawakawa, Auckland, and Taranaki pounders stand in a regional relationship which is also probably a time relationship.

The possible derivation of classic Maori culture from a centre or centres in Northland is a theory which has been put forward in recent years (Groube 1968, Simmons 1969). The evidence of a few pounders and of the degeneration or simplification of the anthropomorphic form of these between Northland and Taranaki is not conclusive but is certainly suggestive.

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IDENTIFICATION OF ARCHAEOLOGICAL AND ETHNOLOGICAL SPECIMENS OF FIBRE-PLANT MATERIAL USED BY THE MAORI

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Abstract. Criteria and a key are given for the identification of thirteen fibre-plants found in New Zealand archaeological excavations, random collections from cave sites and rock shelters, and/or in the Ethnology collections of the Auckland Institute and Museum: *Astelia, Bulbinella gibbsii* var. *balanifera, Cordyline, Cortaderia toetoe, Dracophyllum, Eleocharis sphacelata, Freycinetia banksii, Hierochloe redolens, Phormium, Rhopalostylis sapida, Desmoschoenus spiralis, Typha orientalis* and *Uncinia rubra.*

Before the arrival of European settlers in New Zealand several indigenous fibre-plants, in addition to *Phormium,* were used by the Maori in making clothing, mats, baskets and cordage. There is no complete list of all the plants used by the Maori for domestic and economic purposes; there are, however, numerous references in the writings of Colenso, Best, Hamilton, Buck and other authors.

Fig. 1. *Bulbinella gibbsii* var. *balanifera,* Fiordland; remains of plaited leaves, Herb. AK 122362.

Rec. Auckland Inst. Mus. 8: 57-101 December 17th 1971.

Leaves of the genus *Bulbinella* (Fig.1), not mentioned by any of the foregoing authors, have been identified recently in a large collection of archaeological material from Fiordland, sent for identification by Mr Peter Coutts, Myer Research Fellow in Prehistory, Otago University. The fragments of plaited *Bulbinella* suggest that the Maori may have used any available plant for immediate and temporary purposes.

Since finding the *Bulbinella,* plant fragments collected from North Island cave sites and rock shelters and preserved in the Auckland Institute and Museum Ethnology Department have been examined. These collections are from the Poor Knights Islands, Whangaroa, Anawhata, Piha, Whatipu and Lake Taupo. Maori baskets, belts, cloaks, cordage, kilts, kites, mats, oven bands, pack straps, poi rain capes and sandals in the Ethnology Department were also examined, and in most cases the plant materials used were identified. The genus and, where possible, the species were determined from the structure, appearance and texture of prepared or unprepared leaf fragments and fibre, without the usual aids of flowers and fruit. Comparisons were made with both fresh and dried plant specimens and all material was examined under a microscope (20 X).

As a possible aid to future workers the notes prepared when determining the plant material have been expanded and set out below. The plants are discussed in the following sequence:—

1. Those found in archaeological excavations, and collections from cave sites and rock shelters.

2. Those plants which have been used in the manufacture of articles preserved in the Ethnology Department, but not, so far, found in archaeological material.

3. Those plants mentioned in the literature as having been used by the Maori but, as yet, not found in any of the material available.

Apart from the few figures inserted in the text, all plates are arranged firstly so that archaeological specimens precede ethnological material and secondly so that all rope is together, all baskets are together, and so on. It is hoped that this will facilitate comparison and identification of the fibre-plants used in newly-found material.

Fibre-Plants in Archaeological Collections

In this section fragments of plant material found in archaeological excavations, cave sites and rock shelters are identified. Where possible, references to literature which mentions the use of similar Maori fibre-plants are given, together with lists of selected Maori artifacts made from the same material and held in the Ethnology collections of the Auckland Institute and Museum.

Phormium (Agavaceae) New Zealand flax

The genus of two species is endemic to New Zealand and Norfolk Island. The leaves are described by Cheeseman (1925, p. 320) as, "all radical, long, linear-ensiform, equitant and distichous, exceedingly tough and coriaceous."

The leaves of *Phormium tenax* J. R. & G. Forst, provided the Maori with suitable material for making clothing, mats, baskets and cordage. Mats, belts, baskets and ropes were plaited from strips of the green leaf; ropes, lashings and fishing lines were plaited from the dressed fibre, which was also woven into cloaks. It is likely that the leaves of *P. cookianum* Le Jolis were also used by the Maori but the fibre was considered inferior and was not used to the same extent as *P. tenax*. No specific identification of the two plants has been made here.

Selected references, from the literature, to the Maori uses of *Phormium* are:—

aprons — Hamilton 1896-1901, p.289; Best 1899, p.645; Buck 1926a, p.47; Duff 1943, p.212; Dodge 1941, p.9; Buck 1949, p.159; Phillipps 1966, p.64, fig.58; Mead 1969, p.122, fig.47.

baskets — Colenso 1869a, p.36; Hamilton 1896-1901, p. 295; Best 1899, p.649, 1924c, p.205, fig. 94; Buck 1923, p.732, 1949, p.154, pl.7.

belts — Hamilton 1896-1901, p.291; Best 1899, p.647, 1924b, p.520, 1924c, p.205, fig.92; Buck 1924, p.346, 1949 p.175; Ryden 1963, p.89, fig. 42; Mead 1969, p.66 fig.18.

cloaks — Colenso 1869a, p. 33, 1869b, p.14; Hamilton 1896-1901, p.283-289, pl.38; Best 1899, p.639, 1924b, p.514; Buck 1911, p.77, 1926a, p.51-58, pl.23, 1949, p.169, pl.12; Roth 1923, p.40; Dodge 1941, p.10-14; Ryden 1963, p.80, pl.29; Mead 1969, many references and illustrations.

fire-fans — Buck 1924, p. 353, pl.37, 1949, p.156.

fishing lines — Colenso 1869a, p.35; Best 1924c, p.257, fig.120; Buck 1949, p.216.

fishing nets — Best 1903, p.72-81, 1924c, p.243-251; Buck 1926b, p.597-646 ill.

fly traps — Buck 1924, p.355, pl.37.

food baskets — Hamilton 1896-1901, p.295; Buck 1923, p.726-732, pls.78,82; Best 1924a, p.419.

kilts — Hamilton 1896-1901, p.290; Best 1899, p.642; Buck 1911, p.88-90; 1926a, p.47-51, pl. 15, 1949, p.175; Roth 1923, p.48; Dodge 1941, p.9, pl. 3; Mead 1969, pl.119-120, fig.46.

mats — Colenso 1869a, p.35, 1869b, p.14; Hamilton 1896-1901, p.297; Best 1899, p.655, 1924b, p.525; Buck 1923, p.716-725, pl.81, 1949, p.149.

oven bands — Buck 1924, p.350-353, pl.36.

pack straps — Hamilton 1896-1901, p.291; Buck 1923, p.738-739, pl.82; Best 1924a, p.404, ill.

rain capes — Colenso 1869b, p.14; Hamilton 1896-1901, p.287; Best 1899, p. 641, 1924c, p.201, fig.89; Roth 1923, p.46; Buck 1926a, p.136, pls.19,38, 1949, p.166; Mead 1969, p.117-119, fig.25a.

rope and cordage — Best 1924b, p.531 ill., 1924c, p.208 fig. 96.

sails — Buck 1924, p.361, 1949, p.156.

sandals — Hamilton 1896-1901, p.293; Best 1899, p.653; 1924b, p.522; Buck 1924, p.357, 1949, p.156; Mead 1969, p.123.

Selected reference specimens in the Ethnology collections of the Auckland Institute and Museum are listed below. In this and subsequent lists, "Eth." indicates the accession number in the Ethnology collection, dimensions in cm are maxima and these are followed by locality (where known) and date of accession.

Eth. 820 apron, triangular, woven, with black twisted thrums; 65x69x58cm; illustrated in Mead 1969, fig.47a (not 47b, as stated); 1901.

Eth. 740 basket "for straining the juice of tutu berries" made of leaf strips 4mm wide; 19x21cm; 1899. (Fig.57).

Eth. 6874 basket, closely plaited, of leaf strips 5mm wide; 43x32cm; 1925. (Fig.63).

Eth. 13875.1 basket, openly plaited, of narrow leaf strips 2mm wide; 57x28cm; 1930. (Fig.60).

Eth. 7678 basket "for cooking food in hot springs", openly plaited, of leaf strips 6mm wide; 30x22cm; loops at top for rope: Ohinemutu, 1920. (Fig.53).

Eth. 7698 basket, plaited in twilled design of natural and black leaf strips 4-8mm wide; 62x44cm; 1917.

Eth. 672 belt, folded, made of natural and black leaf strips 2mm wide; 128x10cm; 1875.

Eth. 14650 belt, folded, of natural coloured leaf strips 3mm wide; 141x10cm; 1925.

Eth. 287 cloak, finely woven, with three taniko borders; 158cm wide and 132cm deep; illustrated in Mead 1969, fig.32b; 1887.

Eth. 10637 fire fan, plaited of leaf strips 8mm wide; 22x15cm with loop at one corner; illustrated in Buck 1924, pl.37, fig.1; 1927.

Eth. 1431? fishing line of very fine two-ply twisted fibre, 1mm diameter; large hank, golden brown; (probably Grey collection).

Eth. 38819 fishing net, conical, knotted, of leaf strips 2mm wide; 85cm long, 60cm wide at base, tapering to a point; Anawhata, 1968. (Fig.23).

Eth. 4666 net, knotted, of leaf strips 3mm wide on mussel dredge; 1930.

Eth. 785 food basket, closely plaited of leaf strips 4mm wide; c.13cm square and 3cm deep; Kaipara, 1899. (Fig.51).

Eth. 292 kilt, 133cm wide and 78cm deep, with short tags of curled leaf scraped at intervals; illustrated in Mead 1969, fig. 27b; 1887.

Eth. 825 kilt, 94cm wide and 56cm deep, with long tags of curled leaf scraped at long intervals; illustrated in Mead 1969, fig.27a; 1901.

Eth. 6885 mat, plaited, of leaf strips 5mm wide; 259x153cm; Gisborne, 1925.

Eth. 3868 oven band, twisted, of leaf strips 3mm wide made into a thick 3-ply plait tapering at both ends; 120cm long and 8cm wide at centre; similar to illustration in Buck 1924, pl.36, fig.3; 1924.

Eth. 5489 oven band, plaited, of leaf strips 1cm wide, flat; 138x17cm; Kaipara, 1911.

Eth. 3866 oven mat, "for covering food in cooking oven. Tags at four corners for lifting off"; plaited, of leaf strips 7mm wide; 90x49cm; Taranaki, 1924.

Eth. 1053 pack strap of two plaited bands made of leaf strips 4mm wide 288cm long; joined at centre by band 13x3.4cm; 1927.

Eth. 314 rain cape, 100cm wide and 77cm deep, with long folded tags of fibre 20-40cm long; illustrated in Mead 1969, fig.24a as "kahu toi"; 1887.

Eth. 5569 rain cape, 113cm wide and 76cm deep, with wide folded tags of leaf strips, 16x1cm; illustrated in Mead 1969, fig.25a; 1912.

Eth. 1048 rope of roughly prepared fibre; flat plait 8mm wide; large hank; Taranaki, 1927.

Eth. 1075 sandal, plaited of leaf strips 1cm wide; 28x10cm; 1927. (Fig.45).

Maori preparation of *Phormium* fibre

The midrib and margins of the leaf were torn off and discarded, then with the aid of the sharp edge of a mussel shell the lower surface of the leaf was peeled off leaving the long strip of the upper surface of the leaf containing the best fibre. This strip was scraped to remove the epidermis and tissue from the fibre which was then soaked in water for several days; beaten between stones; scraped again and resoaked, then spread on the ground to bleach and dry; beaten again to remove any adhering tissue, and finally worked and twisted for the purpose required. For softness and colour, fibre hand-dressed by the Maori far surpassed any machine-dressed *Phormium* fibre. The painstaking preparation by the Maori is described by several authors.

Some terms used in describing the Maori method of preparing *Phormium* fibre are as follows:

Stripping. The lower surface of the leaf was peeled from the upper surface with the edge of a shell or piece of obsidian. (This should not be confused with the tearing into strips of the green leaf for plaiting into baskets and mats.)

Scraping. After stripping, the remaining upper surface was scraped with a shell to remove adhering epidermis and tissue.

Dressed fibre. After stripping, scraping, washing, beating and bleaching, the fibre was twisted by rubbing between the hands or against the thigh and was ready for weaving into cloaks or plaiting into fine cordage.

European preparation of *Phormium* fibre

Some terms used in European mechanical preparation of *Phormium fibre* are given for comparison.

Stripping. The first process, when the fibre is extracted from the green leaf by a stripping machine.

Scutching. After stripping, washing and bleaching, any remaining extraneous matter is removed from the fibre by beating in a scutching machine.

Dressed fibre. The finished fibre which is ready for making into rope and cordage of various sizes.

Characters for the identification of *Phormium* leaves in archaeological and ethnological material are:

Leaves long, flat, leathery, sword-shaped, 1-4m long, 5-13cm wide; folded and coalescent at the base; light brown, occasionally retaining some green colouring; midrib keeled, coloured red or yellow; margins ribbed, coloured red, yellow or black; veins numerous, even, parallel. (In *P. cookianum* midrib and margins not usually coloured; leaf paler green.)

Upper surface of leaf lustrous, glabrous, papery, pale yellowish-brown; midrib sunken; veins parallel, fairly evenly spaced, not very apparent; margins ribbed, coloured red, yellow or black. (Margins not usually coloured in *P. cookianum.)*

Lower surface of leaf dull, glabrous, furrowed, darker brown than upper surface; midrib prominent, keeled, coloured red or yellow; veins parallel, fairly evenly spaced, prominent; margins ribbed, coloured red, yellow or black. (Margins not usually coloured in *P. cookianum.)*

Fibre. In remains of unprepared or lightly scraped leaf, fibre bundles compressed, flat, pliable, dull, light to dark brown, *c.* 0.3mm - 0.4mm wide.
(Fibre bundles measured occur in leaves in compressed bands associated with vascular bundles and consist of strands of numerous thin elongated cells bound together. Single or ultimate fibres not measured.)

In well dressed fibre (scraped, beaten, washed and bleached), bundles round, pliable, soft, lustrous, with occasional pieces of shiny epidermis adhering; *c.* 0.05mm - 0.1mm wide; cream or golden coloured in fine cloaks.

Selected archaeological reference fragments from cave sites (north to south) held in the Herbarium of the Auckland Institute and Museum are listed below. In this and subsequent lists, "Herb. AK" indicates the number of the voucher specimen in the Herbarium; other information given includes locality, collector, date of collection and assumed use of specimen.

Herb. AK 126559 (Eth. 21172.1) Whangaroa, V. Fisher, 1934; fragments of plaited rope.

Herb. AK 126044 (Eth. 23883.2) Anawhata, F. Mappin & A. T. Pycroft, 1928; bundle of matting plaited in strips 3 mm wide.

Herb. AK 126045 (Eth. 23889) same locality, collector and date; remains of cape. (Fig. 28).

Herb. AK 126043 (Eth. 23883) same locality, collector and date; remains of net. (Fig. 25).

Herb. AK 123896 (Eth. 31112) Lion rock, Piha, C. Trevarthen, 1949; fragments of woven cloak.

Herb. AK 125308 (Eth. 19777.1) between Piha and Karekare, F. Mappin, 1933; remains of knotted leaf.

Herb. AK 125617 (Eth. 19776.2) same locality, collector and date; belt, 97 cm long, 8 cm wide, plaited in strips 3 mm wide. (Fig. 36).

Herb. AK 126132 (Eth. 43172.2) Piha, Errol Willis, 1959(?); large fragment of basket with two handles, plaited in strips 5 mm wide.

Herb. AK 126251 (Eth. 24672) Piha, W. E. Browne, 1939(?); fragment of woven cloak.

Herb. AK. 126259 (Eth. 17107.1) Paratutai, Whatipu, J. Donald and G. Fairfield, 1931; pieces of plaited rope, *c.* 7 mm wide.

Herb. AK 125874 (Eth. 34802.1) Motutaiko I., Lake Taupo, T. Hosking, 1956; pieces of woven cloak. (Fig. 27).

Herb. AK 125875 (Eth. 34802.2) same locality, collector and date; thick twist of fibre, 1 cm diameter.

Herb. AK 126255 (Eth. 35823) Lake Taupo, W. H. Boucher, 1957; small basket "for holding kokowai", 15 x 9.5 cm, close plait of strips 3 mm wide. (Fig. 42).

Herb. AK 126249 (Eth. 35832) same locality, collector, and date; finely woven bag, 30 x 24 cm. (Fig. 44).

Herb. AK 126257 (Eth. 35831.4) same locality, collector and date; long rope 160 cm, 2 cm diam.

Herb. AK 126588 (Eth. 35829) same locality, collector and date; plaited bag, 45 cm long, 10 cm wide at centre, with knotted cord 43 cm long attached at each end; "used for expressing oil from titoki and other berries by a twisting process — tapers each end to a stout plaited cord"; leaf strips 5 mm wide. (Fig. 32).

Herb. AK 126584 (Eth. 35824) same locality, collector and date; twilled basket 34 x 24 cm, of plaited strips 4 mm wide.

Herb. AK. 126585 (Eth. 35841) same locality, collector and date; remains of large basket, coarsely plaited in strips 8 mm wide.

Herb. AK 122363 Fiordland, P. J. F. Coutts, 1969; remains of plaited rope, 8-10 mm wide, made of strips of unscraped leaf.

Herb. AK 122060 same locality, collector and date; remains of plaited rope, 5-10 mm wide, of scraped leaf. (Fig. 20).

Herb. AK 126108 same locality, collector and date; fragments of plaited belt. (Fig. 14).

Herb. AK 121854 same locality, collector and date; fragment of fine plaited material of leaf made of strips of unscraped leaf.

Herb. AK 121859 same locality, collector and date; fragments of knotted net. (Fig. 24).

Herb. AK 122114 same locality, collector and date; remains of knotted leaf. (Fig. 10).

Herb. AK 121857 same locality, collector and date; stripped midribs and margins of leaves.

The main diagnostic characters of *Phormium* leaf in the material examined are the shiny epidermis, the coloured keeled midrib on the lower surface, the coloured margins and the even veins. The fibre in unprepared leaf is in flattened bands and the dressed fibre is very pliable and soft with the separate fibres very fine round and lustrous.

Cordyline (Agavaceae) ti or cabbage tree

Five indigenous species are keyed and described by Moore and Edgar in the latest treatment of the genus in *Flora of New Zealand Vol. 2,* (1970, p. 47), and the adventive species, *C. terminalis,* is mentioned. The leaves of *Cordyline* were described by Cheeseman (1925, p. 309):— "crowded at the top of the stem or

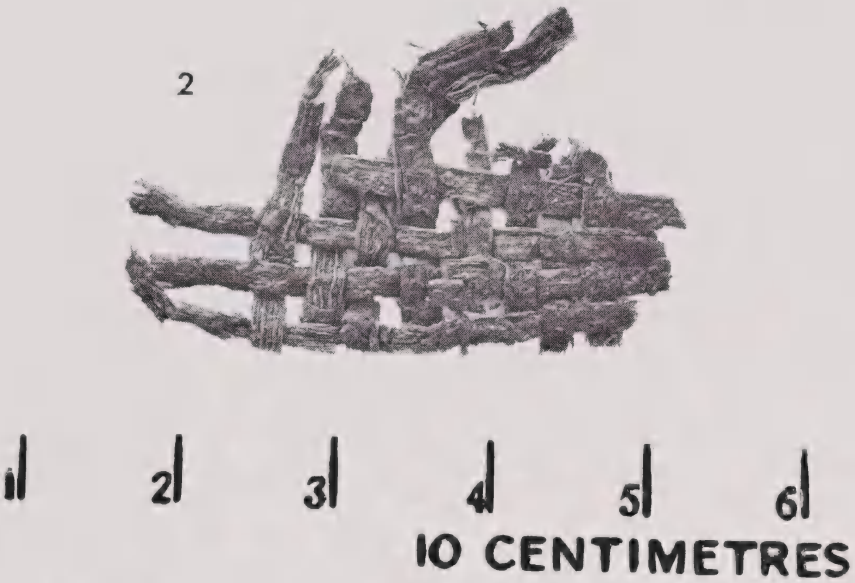


Fig. 2. *Phormium* sp., Fiordland; plaited fragment, Herb. AK 121854.

its branches, more rarely alternate along the stem, sessile or petioled, very long, coriaceous; veins parallel, more or less oblique to the midrib."

The Maori uses of *Cordyline* cited in the literature are:—

baskets — Colenso 1869a, p. 36; Hamilton 1897, p. 295; Best, 1903, p. 57, 1924a, p. 430, illustrated p. 431, 1942b, p. 525; Buck 1923, p. 708; Phillipps 1966, p. 146.

bird snares — Best 1924b, p. 459, 1924c, p. 182; Buck 1949, p. 93.

cordage — Colenso 1869b, p. 14; Buck 1923, p. 708, 1949, p. 125; Best 1924b, p. 531.

rain capes — Colenso 1869a, p. 33, 1869b, p. 14; Hamilton 1897, p. 281; Buck 1911, p. 87, 1923, p. 708, 1926a, p. 51, pl. 16, 1949 p. 167; Best 1924b, p. 518, 1924c, p. 201, fig. 89; Dodge 1941, p. 9, pl. 2; Ryden 1963, pp. 83-84, figs. 33,34; Phillipps 1966, p. 64; Mead 1969, pp. 62,117.

sandals — Hamilton 1897, p. 294, 1896-1901, p. 175, pl. 9; Buck 1923, p. 708, 1924, p. 357; Best 1924b, p. 522; Mead 1969, p. 123.

thatching — Colenso 1869a, p. 34; Best 1924c, p. 299.

Selected reference specimens in the Ethnology collections of the Auckland Institute and Museum are:—

Eth. 3865 basket, plaited, of leaf strips 13 mm wide; 51 x 27 cm; 1924. (Fig. 62).

Eth. 7696 basket, plaited, of leaf strips 4mm wide; 40 x 32 cm; with *Phormium* handles; 1917.

Eth. 8299 basket, plaited, of leaf strips 2mm wide in twilled design; 52 x 27 cm; with *Phormium* handles; 1924. (Fig. 61).

Eth. 18107 basket, plaited, of leaf strips 5 mm wide; 35.5 x 24 cm; dyed : 1932.

Eth. 3867 food basket, plaited, of leaf strips 15 mm wide; c. 23 cm square, 6 cm deep; 1924. (Fig. 50.)

Eth. 775 rain cape of *C. indivisa* fibre; 80 x 92cm; with long, folded, leaf tags; illustrated by Mead 1969, fig. 44b, as "timu"; 1899.

Eth. 5252 rain cape of *Cordyline* fibre; 90 x 120cm, with long folded tags of fibre; illustrated by Mead 1969, fig. 45a, as "pota"; 1910.

Eth. 1083 rain cape of *C. indivisa* fibre; 85 cm x 102 cm; with long folded tags of fibre; illustrated by Buck 1926a, pl. 16, Maketu, Bay of Plenty, 1927.

Eth. 20640 rain cape of *C. indivisa* fibre; 75 x 100 cm; with long, folded tags of fibre; illustrated by Mead 1969, fig. 62; Rotorua, 1934.

Eth. 6180 sandals with soles of *Cordyline* leaf strips 1 cm wide; 32 x 13 cm; with *Phormium* ties; West Coast, South Island, 1918. (Fig. 46).

Maori preparation of Cordyline

Cordyline fibre was twisted into cordage and also used in weaving rain capes (Fig. 3). In the Maori preparation of fibre the midribs were first taken out and the leaves were softened by beating (Best, 1898, p.643). In another method the leaves were softened in a steam oven, then soaked in water and the remaining fibre was shaken out and scraped, then twisted into hanks ready to be woven (Buck 1911, p. 87). When making rain capes from C. *indivisa* the Maori cut only enough green leaves for one day's weaving as the fibre could not be separated from the vegetable tissue when the leaves dried (Best 1899, p. 643; Hamilton 1896-1901, p. 281).

Fig. 3. *Cordyline* sp., Taupo; remains of rain cape, Eth. 35842.

Cordyline australis, abundant throughout New Zealand, and *C. indivisa,* common in subalpine areas of the North Island and west coast of the South Island, were the species most used by the Maori.

Characters for the identification of *Cordyline* leaves in archaeological and ethnological material are:—

Cordyline australis (Forst.f.) Endl. ti or cabbage tree

Leaves long and narrow, flat, leathery, sword-shaped, 30-100 cm long, 3-6 cm wide; contracted above a broad sheathing base; light to dark brown; midrib indistinct; margins not coloured; veins fine and parallel.

Upper surface of leaf slightly lustrous, glabrous, papery, light to dark brown; midrib not apparent; veins parallel, unevenly spaced and of uneven thickness; margins ribbed, not coloured.

Lower surface of leaf slightly lustrous, glabrous, papery, pale to dark brown; midrib apparent, rounded, sometimes yellowish; veins parallel, unevenly spaced and of uneven thickness with coarser veins prominent; margins ribbed, not coloured.

Fibre. In remains of unprepared leaf, fibre bundles oval or crescent-shaped, finely striate, coarse, stiff, straight, dull, medium to dark brown, with some fragments of epidermis often attached at each side, *c.* 0.4 - 0.5 mm wide.

In specimens of dressed fibre, bundles similar but finer, *c.* 0.2 - 0.3 mm wide.

Cordyline indivisa (Forst.f.) Steud. toi

Leaves long, wide, flat, very leathery, sword-shaped, 1-2 m long, 10 - 15 cm wide; contracted above a broad sheathing base; brown; midrib reddish, thick, prominent at base; veins strong, parallel, reddish.

Upper surface of leaf dull, glabrous, bright yellowish brown to dark brown; midrib prominent, wide, flat or grooved, reddish or orange; veins parallel, oblique to midrib, fine, uneven, with many prominent side veins, reddish or orange; margins thin.

Lower surface of leaf dull, glabrous, paler than upper surface; midrib prominent, wide, flat at base, keeled further up, reddish or orange; veins similar to upper surface but less prominent; margins thin.

Fibre similar to *C. australis*, but slightly coarser and darker.

Selected archaeological specimens in the Herbarium of the Auckland Institute and Museum from cave sites are:—

Herb. AK 126256 Eth. 24338 Aorangi I., Poor Knights Islands, C. A. Fleming, 1938; bundle of fibre, some plaited. (Fig. 19).

Herb. AK 125882 (Eth. 23887) Anawhata, F. Mappin & A. T. Pycroft, 1928; knotted leaf. (Fig. 11).

Herb. AK 125883 (Eth. 17114) Paratutai, Whatipu, J. Donald & G. Fairfield, 1931; remains of plaited mat.

Herb. AK 126248 (Eth. 35842) Lake Taupo, W. H. Boucher, 1957; remains of top of rain cape. (Fig. 3).

Herb. AK 126427 (Eth. 35883) same locality, collector and date; remains of basket, 26 x 25 cm, made of strips 2 - 5 mm wide. (Fig. 41).

Herb. AK 126052 Fiordland, P. J. F. Coutts, 1969; fragment of woven dressed fibre. (Fig. 29).

Herb. AK 122439 & 122422 same locality, collector and date; plaited cordage. (Fig. 17).

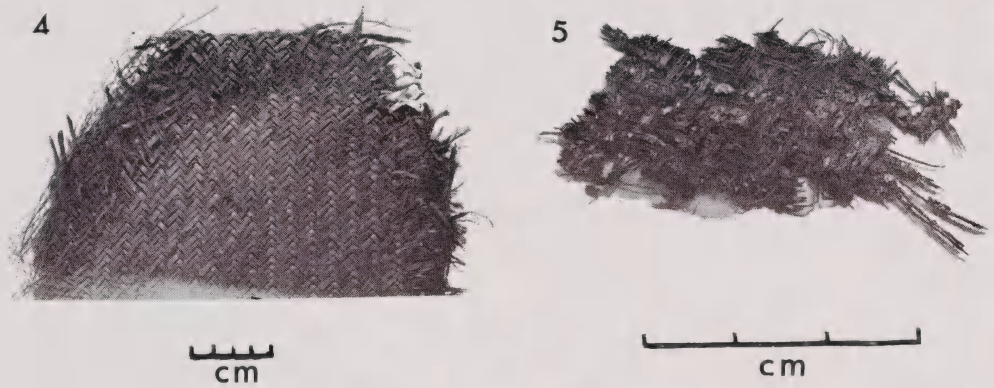
Herb. AK 122115 same locality, collector and date; remains of *Cordyline* leaf. (Fig. 18).

Herb. AK 121863 same locality, collector and date; remains of *C. indivisa* leaf.

Diagnostic characteristics of *Cordyline* leaf are the unevenly spaced ribs (veins) on the epidermis and, in *C. indivisa,* the reddish midrib and prominent side ribs. The fibre is coarser, stiffer and darker than *Phormium* and makes more open plaited cordage.

Freycinetia banksii A. Cunn. (Agavaceae) kiekie

The leaves of the one New Zealand species of *Freycinetia* were described by Cheeseman (1925, p. 123) as "numerous towards the tips of the branches, 1½ - 3ft long, ½ - 1 in. broad, linear-elongate, finely acuminate, broadly sheathing at the base, concave, coriaceous, nerved, margins and midrib minutely spinulose-serrate."



Figs. 4, 5. *Freycinetia banksii.* 4. Taupo; plaited fragment, Eth. 35828. 5. Fiordland; plaited fragment, Herb. AK 126053.

The Maori used kiekie leaves for plaiting (Figs. 4,5) into floor mats, panels, belts and baskets and the fibre in rain capes. The written records of this are:—

baskets — Colenso 1869a, p. 36; Hamilton 1896 - 1901, p. 295; Best 1924b, p. 525; Cheeseman 1925, p. 123.

belts — Best 1924c, p. 205.

lattice-work panels — Colenso 1869a, p. 35; Best 1924c, p. 237.

mats — Colenso 1869a, p. 35, 1869b, p. 14; Hamilton 1896-1901, pp. 273, 297; Best 1899, p. 655, 1924b, p. 525, 1924c, p. 207; Buck 1926a, p. 27.

rain capes — Colenso 1869a, p. 33; Hamilton 1896 - 1901, pp. 281,288; Best 1899, p. 642, 1924b, p. 518; Buck 1911, p.87, 1926a pp. 51,129, 1949, p. 167; Mead 1969, p. 118.

Selected reference specimens in the Ethnology collections of the Auckland Institute and Museum are:—

Eth. 18108 basket "used to contain karaka berries", plaited, of leaf strips, 1.5 cm wide; 68 x 43 cm; 1932.

Eth. 8238 basket, round, closely plaited, of strips 3 mm wide; 38 x 26 cm (flattened); 1924. (Fig. 54).

Eth. 38128.1 basket, closely plaited, of leaf strips 4 mm wide; 47 x 30 cm; "Okere, Rotorua, made c.1930", 1967. (Fig. 64).

Eth. 8234 basket "made of kiekie to hold weaving material", plaited, of strips 4 mm wide, with fringe of fibre at top of basket; 22 cm x 20 cm; Ruatoki, 1902. (Fig. 47).

Eth. 5003 basket in twilled pattern, closely plaited, of leaf strips 3 mm wide; 50 x 24 cm; 1924. (Fig. 65).

Eth. 660 basket in twilled pattern, of leaf strips 3 mm wide; 29 x 18 cm; Waiuku, 1897. (Fig. 59).

Eth. 19483 belt, folded, plaited, of leaf strips 3 mm wide; 111 x 6.5 cm; (measured without ties); 1933. (Fig. 38).

Eth. 315 rain cape tags of leaf strips 7 mm wide, together with dark brown *Phormium* leaf tags, on foundation of woven *Phormium;* cape 190 x 115 cm; 1887.

Eth. 4576 mat, plaited, of strips 5 mm wide, with black pattern of dyed *Phormium* strips; 254 x 226 cm; illustrated by Buck 1949, pl. 6; Waikato, 1930.

Maori preparation of kiekie

In the preparation of kiekie for plaiting into mats the Maori split the leaves into narrow strips which were then bleached by hanging them in the sun until half-dry and then threshing them on the ground until quite white (Best 1899, p. 655). To obtain the fibre, kiekie had to be put through a retting process, and the leaves were steeped in water, until only the fibre remained (Hamilton 1896-1901, p. 288; Best 1899, p. 642). Buck (1949, p. 167) described a method to remove the extraneous tissue from soaked leaves by pulling them through the fingers until only the fibre was left. Another process described by Buck (1911, p. 87) was the softening of leaf strips in a steam oven, before soaking in still water and finally scraping to obtain the fibre.

Characters for the identification of *Freycinetia banksii* leaves in archaeological and ethnological material are:—

Leaves long, narrow, 46 - 100 cm long, 2 - 2.5 cm wide; light brown; midrib and margins minutely toothed; veins parallel. (Wide side veins on fresh leaves not apparent in dried material).

Upper surface of leaf slightly shiny, glabrous, putty colour to light brown; midrib not apparent; margins minutely toothed; parallel veins fine.

Lower surface of leaf (Fig. 68) dull, glabrous, light brown; midrib prominent and minutely toothed; margins minutely toothed; parallel veins more distinct than on upper surface; stomata sometimes apparent.

Fibre. In archaeological remains, fibre bundles round or oval, soft, shiny, putty coloured; *c.* 0.3 mm wide.

Voucher specimens of material from cave sites in the Herbarium of the Auckland Institute and Museum are:—

Herb. AK 126038 (Eth. 21172.2) Taupo Bay, Whangaroa, V. Fisher, 1934; small bundle of fibre.

Herb. AK 125881 (Eth. 23887.1) Anawhata, F. Mappin & A. T. Pycroft, 1928; large fragment of rain cape.

Herb. AK 125879 (Eth. 23887.2) same locality, collectors and date; 3 wide plaits of fibre from cape(?); plaits 1.5 - 2.5 cm wide. (Fig. 26).

Herb. AK 126046.2 (Eth. 23883.1) same locality, collectors and date; fragment of mat made of *Freycinetia* and *Phormium.*

Herb. AK 126270 (Eth. 19775.4) Piha. F. Mappin, 1933; fragment (18 x 10 cm) of basket(?), of twilled plait, of leaf strips 5 mm wide. (Fig. 31).

Herb. AK 126048 (Eth. 19776) same locality, collector and date; remains of folded belt, 119 x 10 cm; twilled plait, of leaf strips 2 mm wide. (Fig. 37).

Herb. AK 126130 (Eth. 43127.1) Piha, E. Willis, 1959, basket with two handles, 30 x 17 cm; plaited, of leaf strips 4 mm wide. (Fig. 43).

Herb. AK 126129 (Eth. 35827) Lake Taupo, W. H. Boucher, 1957; remains of folded belt, 30 x 8 cm; plaited, of strips 2 mm wide. (Fig. 40).

Herb. AK 126128 (Eth. 35838) same locality, collector and date; remains of basket probably 52 x 28 cm, plaited, of leaf strips 3 mm wide. (Fig. 39).

Herb. AK 126187 (Eth. 35828) same locality, collector and date; long plaited fragment, probably part of mat; 56 x 23 cm, of leaf strips 4 mm wide. (Fig. 4).

Herb. AK 126258 (Eth. 35831.1-3) same locality, collector and date; several lengths of rope up to 160 cm long, *c.* 1.5 cm diameter; of leaf strips 5mm wide (Fig. 21).

Herb. AK 126053 Fiordland, P. J. F. Coutts, 1969; fragment of twilled plaited material, of strips 2mm wide. (Fig. 5).

Distinguishing features of *Freycinetia banksii* are the pale, coarse but soft fibre, and the minute teeth on leaf midribs and margins.

Cortaderia toetoe Zotov (Gramineae) toetoe

Toetoe is a tall, perennial, reed-like grass with graceful drooping flower panicles on stems up to 3 metres high. It was described by Cheeseman (1925, p. 180) under *Arundo conspicua* Forst.f. as, "Forming huge dense tussocks with numerous long curving leaves. Culms 3-10 ft high, as thick as the finger at the base, slender, erect, smooth, hollow. Leaves long, narrow, coriaceous, flat or involute, strongly nerved, smooth or scabrid along the margins and on the nerves of the upper surface; sheaths long, smooth; ligules reduced to a transverse band of short stiff hairs . . . "

The leaves and dried flower stalks were used by the Maori for several purposes. The roofs and walls of houses were thatched with layers of stalks and leaf, and split stalks were used as lining in decorative inside wall panels (tukutuku) and as battens for kites. The leaves were probably plaited into floor mats and there is a plaited basket in the Ethnology collection of the Auckland Institute and Museum, which was used for cooking food in thermal pools at Rotorua.

The Maori uses of *Cortaderia,* cited in the literature, are:—

baskets — Colenso 1869a, p.36.

kites — Best 1924b, p. 119, 1925b, p. 75.

lining for roofs and walls of houses — Colenso 1869a, p. 35; Hamilton 1896 - 1901, p. 85; Best 1924c, p. 235; Cheeseman 1925, p. 181; Buck 1949, p. 127.

mats — Colenso 1869b, p. 14.

thatch — Buck 1949, p. 127.

Examples in the Ethnology collections of the Auckland Institute and Museum are:—

Eth. 1050 basket, plaited, of leaf strips 2 mm wide; 33.5 x 18 cm; 1927.

Eth. 31052 basket, plaited, of leaf strips 4 mm wide; 19 x 18 cm, with loops at top threaded with long *Phormium* rope, 120 x 1 cm; "used for cooking in boiling pools"; Rotorua; 1949. (Fig. 52).

Eth. 5068 kite, triangular, 67 x 67 x 52 cm; *Typha* laced on *Cortaderia* stalks; Urewera; 1903.

The Maori meeting house, Hotunui, in the Auckland Museum, has a thatch of toetoe leaf and decorative panels of toetoe stalks (kakaho).

Characters for the identification of *Cortaderia toetoe* leaf in archaeological and ethnological material are:—

Leaves long, stiff, flat or involute; up to 2 m long x 1.5 cm wide, tapering to thin point; long basal sheath expanding to *c.* 3.5 cm at base; midrib continuing down sheath; margins smooth towards base, rough to touch towards tip, with small prickles; pale yellow-green to yellow-brown; veins parallel.

Upper surface of leaf slightly lustrous, flat or rolled, glabrous, pale yellow-green to yellow-brown; midrib hard, prominent, rounded; margins with small prickles; parallel veins ridged, flat-topped.

Lower surface of leaf dull, flat or rolled, scabrous; paler colour than upper surface; midrib and several side veins prominent; smaller veins flat-topped, with minute prickle-hairs between veins; margins with small prickles.

Fibre. In archaeological material, dark brown, coarse, stiff, flat, striate; *c.* 2 mm wide; pieces of hard midrib *c.* 3 mm wide.

A voucher specimen of archaeological material in the Herbarium of the Auckland Institute and Museum is:—

Herb. AK 126272 (Eth. 26448.3) cave site, Piha, W. E. Browne, 1941; remains of large plaited basket with plaited cord at top. (Fig. 33).

Diagnostic characters of this *Cortaderia* are the hard midrib, pronounced side ribs and flat-topped smaller ribs, the roughness of the lower surface and the prickles on the margins of the leaves.

Rhopalostylis sapida Wendl. & Drude (Palmae) nikau

Two species of *Rhopalostylis* are keyed and described by Moore and Edgar (1970, p. 96); one is found in the Kermadec Islands and one in New Zealand. The latter is *Rhopalostylis sapida,* which is abundant in the North Island, and found in lowland coastal areas in the South Island as far south as Banks Peninsula and Hokitika. Cheeseman (1925, p. 281) described the leaves as "forming a terminal crown, pinnate; petiole long, furnished at the base with a long and broad sheathing part. Leaflets long, narrow, acuminate, slightly falcate at the apex, 3-costulate; secondary nerves several, distant; margins thin."

The leaves were used by the Maori for making baskets, lining roofs, and possibly for floor mats and cooking. Records from the literature are:—

baskets — Colenso 1869a, p. 36; Hamilton 1896 - 1901, p. 338, pl. 44, fig. 1; Buck 1923, pp. 709, 726, 1949, p. 154.

floor mats — Colenso 1869b, p. 14; Buck 1949, p. 149.

in cooking rats wrapped in leaves — Best 1924b, p. 502.

roof lining — Hamilton 1896 - 1901, p. 90.

An example in the Ethnology collection of the Auckland Institute and Museum is:—

Eth. 6402 basket (kete nikau), 32 x 27 cm, of leaf strips 8 - 12 mm wide; Kaipara, 1923. (Fig. 56).

Characters for the identification of *Rhopalostylis sapida* leaf in archaeological material are:—

Leaves pinnate, 1 - 3 m long; numerous leaflets *c.* 1 m long, 25 - 50 mm wide, linear sword-shaped; greenish brown; midrib and main veins fairly prominent; veins distant with faint transverse arched veinlets; margins thin.

Upper surface of leaflet dull, glabrous, greenish brown; midrib apparent; veins parallel, widely spaced, connected by infrequent arched veinlets; two stout side veins apparent; margins thin, not coloured.

Lower surface of leaflet similar to upper surface except midrib prominent, often reddish.

Fibre. In unprepared leaf remains, fibre bundles round, fine and coarse, striate, soft, sometimes shiny, mostly attached to epidermis, light brown, *c.* 0.2 - 0.45 mm wide.

Voucher specimens of archaeological material from cave sites, in the Herbarium of the Auckland Institute and Museum are:—

Herb, AK 125878 (Eth. 23887) Anawhata, F. Mappin and A. T. Pycroft, 1928; leaflets roughly plaited in a circle. (Fig. 30).

Herb. AK 121810 Fiordland, P. J. F. Coutts, 1969; fragments of leaf. (Fig 13).

Diagnostic characters for the recognition of *Rhopalostylis sapida* leaflets are the green colouring within the tissue, the prominent reddish midrib, the two widely spaced side veins, and the occasional arched linking veinlets.

Astelia (Liliaceae) perching lily

Cheeseman (1925, p. 312) in listing twelve species of *Astelia* described the leaves of the genus as, "numerous, linear, all radical or crowded near the base of the stem, with broad imbricate sheathing bases." Thirteen species are keyed and described by Moore and Edgar (1970, p. 28). Moore (1966, p. 202) described asteliads as "perennial tufted herbs, the smallest, with leaves at most a few centimetres long . . . while the largest could be mistaken for *Phormium*." Common names for some of the species are given as "bush flax", "tree flax", "perching lily", "kauri-grass", and "kahakaha" or "kokaha" (Andersen 1926, p. 680).

The leaves were used by the Maori for food baskets, oven bands and possibly other temporary purposes. The evidence for this from the literature is:—

food baskets — Best 1903, p. 55, 1924a, p. 419; Buck 1923, p. 708.

oven bands — Best 1903, p. 89, 1924a, p. 417.

No articles made of *Astelia* were found in the Auckland Institute and Museum Ethnology collections.

It is likely that the Maori used several species of *Astelia.* From the width and length of the leaf fragments and the presence of stout reddish side veins, in recently examined Fiordland archaeological material, it is probable that the plant used there was *A. nervosa* Hook. f. and also perhaps *A. petriei* Ckn. The remains of a small basket in Auckland archaeological material appear to be leaves of *A. trinervia* Kirk.

As the asteliads are difficult to identify even in flowering specimens, no specific status has been given to the leaf fragments discussed here.

Characters for the identification of *Astelia* leaves in archaeological and ethnological material are:—

Leaves long and narrow, up to 183 cm long, 2 - 7 cm wide; brown or greyish brown; midrib and two stout side veins sometimes reddish; veins parallel.

Upper surface of leaf dull, glabrous, brown; midrib not always apparent; parallel veins rather widely spaced; two side veins apparent, sometimes stout and coloured; margins thin, in some species recurved.

Lower surface of leaf dull, some appressed silky hairs; silvery-brown; midrib usually conspicuous, sometimes reddish; two stout side veins sometimes more prominent than midrib; margins thin.

Fibre. In unprepared leaf remains, fibre bundles flat and crescent-shaped, slightly hairy, soft, coarse, dull pink-brown; *c.* 0.25 - 0.4 mm wide.

Voucher specimens of archaeological material from cave sites, in the Herbarium of the Auckland Institute and Museum are:—

Herb. AK 125193 (Eth. 19775.1) Piha, F. Mappin, 1933; remains of food basket, 18 x 13 cm, plaited, of leaf strips 14 - 18 mm wide. (Fig. 34).

Herb. AK 126252 (Eth. 35825) Lake Taupo, W. H. Boucher, 1957; basket, 28 x 17 cm with 2 handles; open plait; of leaf strips 3 - 7 mm wide. (Fig. 35).

Herb. AK 121856 Fiordland, P. J. F. Coutts, 1969; remains of knotted leaf. (Fig. 12).

Herb. AK 122070 same locality, collector and date; remains of plaited leaves.

Herb. AK 123225 same locality, collector and date; thin plait of fibre *c.* 5 cm long.

Diagnostic characters for the recognition of asteliad leaf remains are the two stout side veins and the slightly hairy fibre.

Dracophyllum (Epacridaceae) grass tree

Thirty-five species of *Dracophyllum,* native to New Zealand, are described in *Flora of New Zealand* Vol. 1, 1961, by H. H. Allan. The leaves are "simple, of linear order, usually minutely serrulate-crenulate on margins; base prolonged into an appressed sheath . . . " (Allan 1961, p. 521).

In the literature consulted, only Colenso claimed that the Maori used *Dracophyllum* leaves:—

clothing — Colenso 1869a, p. 33, 1869b, p. 14.

As yet no *Dracophyllum* has been found in Ethnological material, nor has the *D. latifolium* of the north, quoted by Colenso, been found in cave remains. From recent examination of plant fragments from Fiordland excavations there is evidence that strips of *Dracophyllum* leaf were plaited into matting or baskets, also into fine cordage. In Fiordland both *D. menziesii* and the larger *D. fiordense* were probably used.

Characters for the identification of *Dracophyllum* leaves in archaeological material are:—

Dracophyllum menziesii Hook.f.

Leaves reflexed, rigid, leathery, red-brown; 7 - 20 cm long, 1 - 2 cm wide at base, gradually tapering to fine point; midrib not very apparent; margins thick, coloured yellow-orange, serrulate to crenulate (with minute pointed or rounded teeth); fine parallel veins.

Upper surface of leaf slightly shiny, glabrous, red-brown; midrib sunken; fine parallel veins slightly ridged; stomata faint.

Lower surface of leaf slightly shiny, glabrous, red-brown; midrib not apparent; fine parallel veins; stomata obvious between veins.

Fibre sparse, flat, soft, brown; fragments of brown or reddish epidermis adhering; 0.2 - 0.3 mm wide.

Dracophyllum fiordense W. R. B. Oliver.

Leaves reflexed, rigid, leathery, red-brown; up to 70 cm long x 5 cm wide at base, gradually tapering to sharp point; margins thin, shining, smooth, without teeth; fine parallel veins.

Upper and lower surface of leaf similar to *D. menziesii;* only margins different, i.e. without teeth.

Fibre similar to *D. menziesii.*

Selected voucher specimens of Fiordland archaeological material in the Herbarium of the Auckland Institute and Museum are:—

Herb. AK 122227 Fiordland, P. J. F. Coutts, 1969; fragments of leaf. (Fig. 15).

Herb. AK 123242 same locality, collector and date; remains of thin plait of fibre 20 cm long.

Herb. AK 126106 same locality, collector and date; fragments of plaited mat or basket(?): 10 x 7 cm; of leaf strips 1 mm wide. (Fig. 16).

Diagnostic characteristics of *Dracophyllum* are the stomata between the veins and in *D. menziesii,* the toothed margins of the leaf and the reddish colour of the epidermis. (Fig. 69).

Bulbinella gibbsii Ckn. var. **balanifera** L. B. Moore (Liliaceae)

Three species of the genus *Bulbinella* were keyed and described by Cheeseman (1925, p. 322) and these were increased to six by Moore and Edgar (1970, p. 22). Bulbinellas are "summer-green perennial herbs" with fleshy strap-shaped leaves (Moore 1964, p. 287-288). *Bulbinella gibbsii* Ckn var. *balanifera* grows in Fiordland.

From recent examination of plant remains from archaeological sites in Fiordland it is apparent that *Bulbinella* leaves were gathered by the Maori and made into plaited baskets and floor mats.

There are no references to Maori use of *Bulbinella* sp. in the literature studied, and no artifacts in the Ethnology collections.

Characters for the identification of *Bulbinella gibbsii* var. *balanifera* leaves in archaeological material are:—

Leaves fleshy, glabrous, concave above, strap-shaped, tapering to blunt tip; 12-22 cm long, 1 - 3 cm wide; yellow-brown; no midrib; margins ribbed, *c.* 0.5 mm wide, coloured yellow or red-brown; veins fine, parallel.

Upper surface of leaf lustrous, glabrous, soft, thin, yellow-brown; no midrib (leaf tubular); veins parallel, fine, close, evenly spaced, not very apparent.

Lower surface of leaf dull, glabrous, soft, thin, paler than upper surface; no midrib; veins parallel, fine, close, evenly spaced (6 ridges to 1 mm) more distinct than upper surface.

Fibre. In remains of unprepared leaf, fibre bundles, when present, oval, slightly hairy, harsh, coarse, dull, very brittle, reddish-brown, *c.* 0.3 - 0.4 mm wide.

Selected voucher specimens of Fiordland archaeological material in the Herbarium of the Auckland Institute and Museum are:—

Herb. AK 121804 Fiordland, P. J. F. Coutts, 1969; fragments of plaited basket (with crayfish remains); leaves *c.* 2cm wide.

Herb. AK 122362 same locality, collector and date; remains of rough plait of leaves; *c.* 22 x 2.5 cm. (Fig. 1).

Herb. AK 121858 same locality, collector and date; remains of leaves 2 cm wide. (Fig. 9).

Herb. AK 122431 same locality, collector and date; fragments of plaited leaf strips 2 mm wide.

Herb. AK 123188 same locality, collector and date; remains of plaited ropes; one piece 38 cm x 7 mm.

Diagnostic characters for the recognition of this *Bulbinella* are the yellow-brown, soft, tubular leaves with no midrib, and the thickened coloured margins (Fig. 67).

Fibre-Plants in Ethnological Collections

Under this heading, plant material from selected Maori artifacts in the Ethnological collections of the Auckland Institute and Museum is identified. Where possible, references to literature applying to the Maori use of similar plants are listed, but none of these plants have been seen in the archaeological collections examined.

Desmoschoenus spiralis (A. Rich.) Hook.f. (Cyperaceae) pingao.

This sedge, 60 - 90 cm high, is abundant on sand dunes on the New Zealand coast. Under the synonym *Scirpus frondosus,* Cheeseman (1925, p. 224) described the leaves as "spreading, often curved, rigidly coriaceous, channelled above, keeled beneath, gradually narrowed into long trigonous points, at the base expanded into broad membranous sheaths; margins and keel sharply denticulate." The leaves when dry are bright yellow and were used by the Maori for the coloured designs in mats, baskets and belts; also in the lattice-work panels of their houses. It is said that "Inland tribes imported the prepared material from their coastal friends" (Buck 1923, p. 708).

References to the Maori uses of pingao are:—

baskets — Buck 1923, p. 708; Cheeseman 1925, p. 225.

belts — Colenso 1869a, p. 33; Buck 1923, p. 708, 1924, p. 348; Best 1924b, p. 520, 1924c, p. 205.

cloaks — Cheeseman 1925, p. 225; Moore and Edgar 1970, p. 171.
lattice-work panels — Colenso 1869a, p. 35; Buck 1923, p. 708; Best 1924c, p. 237.
mats — Buck 1923, p. 708.

Selected reference specimens in the Ethnology collections of the Auckland Institute and Museum are:—

Eth. 18811 basket, small, yellow, plaited, of leaf strips 2 - 6 mm wide; 16.5 x 10 cm; Bay of Islands, 1932. (Fig. 48).

Eth. 37471.3 basket, cream and yellow (natural *Phormium* with pingao design), of leaf strips 3 mm wide; 41 x 21 cm; Opotiki, 1963.

Eth. 37471.9 basket, white, yellow and black (kiekie, pingao and dyed *Phormium*) of leaf strips 5 mm wide; 53 x 27 cm; Opotiki, 1963.

Eth. 9992 basket, black and yellow (dyed *Phormium* and pingao), of leaf strips 4 mm wide; 44 x 26 cm; 1926. (Fig. 58).

Eth. 1854 belt, folded, yellow, plaited, of leaf strips 2 mm wide; 94 x 9 cm; 1928.

Eth. 8219 mat, natural *Phormium* with pingao design, partly made; Ohinemutu, 1925.

Characters for the identification of *Desmoschoenus spiralis* leaf in archaeological and ethnological material are:—

Leaves long, narrow, stiff, folded, often curved; 50 - 60 cm long, 5 - 8 mm wide; gradually tapering to fine point; thin basal sheath up to 6 cm long expanded to 3 cm wide at base; bright yellow; midrib keeled below, with fine teeth; margins with irregular fine, prickly teeth, rough to the touch; veins fine and parallel.

Upper surface of leaf slightly lustrous, glabrous, convex, bright yellow; midrib smooth, grooved; stomata apparent between parallel veins.

Lower surface of leaf dull, glabrous, concave, bright yellow; midrib with fine teeth, keeled; veins slightly more ridged than above, stomata apparent between veins.

Fibre sparse, fine, white, shiny, stiff, straight, flat, *c.* 0.07 mm wide.

The most obvious diagnostic character of dried pingao is the bright yellow colour.

So far, no *Desmoschoenus spiralis* has been found in archaeological material.

Typha orientalis C. B. Presl. (Typhaceae) raupo or bulrush

Typha is found in marshy areas throughout the world and the only species native to New Zealand is *T. orientalis* which is the *T. angustifolia* of Cheeseman (1925, p. 121). It grows up to 3m tall, "usually in large colonies" and is "summer-green" (Moore and Edgar 1970 p. 90). The narrow leaves are sometimes longer than the flowering stems and expand at the base into a convex sheath often up to 30 cm long (Cheeseman 1925, p. 121).

There is evidence that raupo leaves were used extensively for the inner thatching of the walls of Maori houses. Other uses were for canoe sails, fishing rafts, kites and poi. For canoe sails, Best (1925a, p. 179 - 180) said the leaves of raupo were used whole and, not possessing any fibre, were not split or plaited, but laced together by ties at intervals.

References from the literature are:—

canoe sails — Colenso 1869a, p. 35; Best 1925a, pp. 179-187.

fishing floats — Colenso 1869a, p. 35; Best 1924c, p. 251.

fishing rafts — Best 1925a, pp. 137 - 141.

kites — Best 1924b, p. 118, 1925b, pp. 67-79; Buck 1949, p. 248.

poi — Best 1924c, p. 136, 1925b, p. 56; Dodge 1941, p. 22, pl. 7; Buck, 1949, p. 243.

thatch — Colenso 1869a, p. 34; Best 1924b, pp. 567 - 569, 1924c, p. 230; Cheeseman 1925, p. 122; Buck 1949, p. 122.

Selected reference specimens in the Ethnology collections of the Auckland Institute and Museum are:—

Eth. 781 floats, almost round, *c.* 20 cm diameter, made of strips up to 3 cm wide; Kaipara, 1899.

Eth. 782 poi (pair) oval made of strips 2 cm wide; 12 x 7.5 cm diameter, and 16 x 8.5 cm diameter; joined by *Phormium* ties about 30 cm long; Kaipara, 1899.

Eth. 13984 strips of raupo prepared for making poi; 60 x 1-4 cm; Otahuhu, 1931.

Eth. 204 kite, bird-like; 322 x 29 cm wing; 128 cm long body; strips of *Typha* sheath 2 - 3 cm wide, laced on frame of stakes; illustrated in Best 1925b, fig. 32. East Cape district, 1886.

Eth. 5068 kite, triangular, 67 x 67 x 52 cm; strips of *Typha* leaf, 1.5 cm wide, laced on to toetoe stems; Urewera, 1903.

Eth. 318 floats of rolls of *Typha* on fishing net; Thames, 1895.

No number, raft or canoe, 295 cm long; of leaf up to 2 cm wide.

Characters for the identification of *Typha orientalis* leaf in archaeological and ethnological material are:—

Leaves long, narrow, sometimes longer than 244 cm, thin broad basal sheaths up to 5 cm wide, more than 30 cm long, leaf then narrowing to 1.5 cm; flat on one side, rounded on other, tapering, becoming flatter near tip; light brown; margins thin; no midrib; fine parallel veins.

Upper surface of leaf lustrous, glabrous, flat, slightly silky; fine parallel veins apparent; light brown.

Lower surface of leaf slightly lustrous, glabrous, convex; fine raised parallel veins; brown.

Fibre light, brittle, attached to epidermis.

Typha can be recognized by the papery sheath and the cavities in the internal spongy tissue of the leaf of dried material. When the two surfaces of the leaf are torn apart large cavities can be seen in the tissue — air space which makes *Typha* float so well (Fig. 66).

As yet, no archaeological fragments of *Typha* have been found.

Hierochloe redolens R.Br. (Gramineae) karetu

Hierochloe redolens, an erect, sweet-scented perennial grass, abundant in most places throughout New Zealand, was described by Cheeseman (1925, p. 147) as having, "Leaves numerous, shorter than the culms or almost equalling them, ¼ - ½ in. broad, flat, deeply striate, smooth or minutely scaberulous, bright shining green; sheaths long, compressed, deeply striate; ligules broad, scarious."

The scented leaves were plaited into belts and worn by Maori women and the grass was also strewn on the floors of houses. References to these uses in the literature are:—

belts — Hamilton 1896 - 1901, p. 291; Best 1899, p. 648, 1924b, p. 522, 1924c, p. 205, fig. 92; Mead 1969, p. 120.

floor covering — Colenso 1869a, p. 36.

Selected reference specimens in the Ethnology collections of the Auckland Institute and Museum are:—

Eth. 730 woman's belt made of 11 plaited cords 73 cm x 5 mm, with dyed *Phormium* ties 68 cm long; Urewera, 1899.

Eth. 5330 woman's belt made of 5 plaited cords 123 cm x 5 mm, with plain *Phormium* ties 56 cm long; 1908.

Characters for the identification of *Hierochloe redolens* in archaeological and ethnological material are:—

Leaves thin, up to 1 m long, 0.6 - 1.27 cm wide; shining light brown; rough to touch on lower surface.

Upper surface of leaf lustrous, glabrous, flat, striate; shining light brown; midrib inconspicuous; margins ribbed; fine parallel veins, evenly spaced.

Lower surface of leaf dull, scaberulous, flat, pale brown; midrib inconspicuous; margins ribbed, with prickle hairs below; parallel veins fine, flat-topped, covered in minute prickle-hairs.

Fibre not separated from epidermis.

As yet, no archaeological fragments of *Hierochloe* have been seen.

Hierochloe redolens can be recognized by the shining, thin, brown leaf which has prickle hairs on the veins of the lower surface.

Eleocharis sphacelata R.Br. (Cyperaceae) kutakuta

This tall sedge is found in swamps and on margins of lakes throughout New Zealand from sea level to *c.* 800 m altitude. Cheeseman (1925, p. 216) described the stems of *Eleocharis sphacelata* as "stout cylindrical, 1 - 3 ft. high, ¼ in. diam., hollow, transversely septate; sheaths long, membranous." Moore and Edgar (1970, p. 188) describe the raised rings on the culms (stems) of these perennial leafless herbs as "internal transverse septa externally distinct at intervals of 1 - 10 cm, interspersed with septa not visible externally . . . "

The Maori name kutakuta has been used for two plants in the *Cyperaceae*. *Eleocharis sphacelata* in Andersen (1926, p. 689) is called ngawha or kutakuta, whereas in Cheeseman (1925, p. 1089) and in Allan (1961, p. 1001) paopao or kutakuta is applied to *Scirpus lacustris*. Buck (1923, p. 708) listed *S. lacustris* for floor mats and Best (1925b, p. 75) listed *E. sphacelata* (kuta) as a sedge used in making kites.

It is known that in recent times, at Ahipara, North Auckland, *E. sphacelata* growing in fresh-water ditches was used for many years by a local Maori family in the making of soft mats (Mrs R. C. Cooper, pers. comm.).

Selected voucher specimens in the Ethnology collections of the Auckland Institute and Museum are: —

Eth. 9229 basket, closely plaited, of stems 11 mm wide, with upper edge and two rows on the body of the basket serrated; 40 x 26 cm; Ohinemutu, 1926. (Fig. 55).

Eth. 6012 basket, small, closely plaited, of stems 8 mm wide, serrated at top; rectangular base 11 x 8.5 cm, 11 cm high (no join at base); Rotorua, 1915. (Fig. 49).

Eth. 44182 mat, plaited, of stems 1 cm wide; 192 x 111 cm; shining yellow-brown; soft; Waiotemarama, Hokianga (made in 1959), 1971.

Eth. 4434 rain cape with folded tags of *E. sphacelata;* tags c. 16 cm long and 1.5 cm wide; Taranaki, 1929. (Fig. 7).

Characters for the identification of *Eleocharis sphacelata* in archaeological and ethnological material are:—

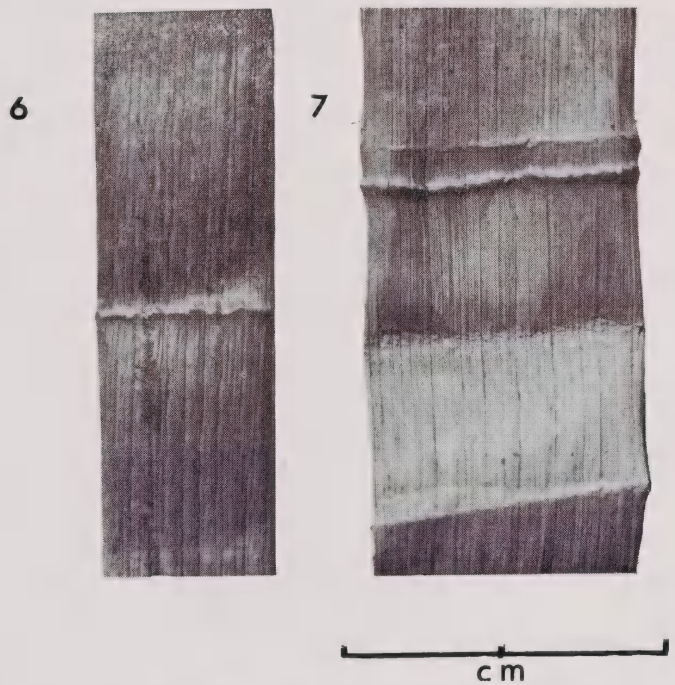
Stems erect, hollow, simple, without perfect leaves; transversely septate; 30.5-91.5 cm long, *c.* 1 cm diameter; light brown.

Outer surface of stem silky, glabrous, papery, finely striate; occasional raised rings at intervals up to 12 cm; light brown.

Inner surface of stem dull, glabrous, papery; numerous porous partition rings; paler than outer surface.

Fibre. Element of epidermis (Esau 1953, p. 205), not noticeably separated therefrom.

Eleocharis sphacelata is easily recognised in ethnological articles by the transversely septate stems, shown by thin raised rings at intervals along the flattened cylindrical stems (Figs. 6, 7).



Figs. 6, 7. *Eleocharis sphacelata.* 6. Dried herbarium specimen, Herb. AK 119696. 7. Tag from rain cape, Eth. 4434.

There was no evidence of *E. sphacelata* in recently examined archaeological material.

Uncinia rubra Boott (Cyperaceae)

Uncinia rubra was described by Cheeseman (1925, p. 249) as "Whole plant red, red-purple, or brownish red, usually forming a continuous sward. Culms 6 - 14 in. high, stout or slender, strict, rigid, leafy at the base, trigonous and scabrid above. Leaves much shorter than culms, rarely equalling or exceeding them, flat or slightly involute . . . . "

There is no record in the literature of this sedge being used by the Maori although several authors mention a red *Carex* known as "maurea" as used in the plaited cords of women's belts.

From a recent examination of a woman's belt (Fig. 8) in the Auckland Museum (Eth. 780), it is apparent that the sedge used was *Uncinia rubra,* not the reddish *Carex commans* as expected from notes in the literature. The long flower stems, or culms, were used rather than the shorter flat leaves. The belt was presented to the Museum by Mr Elsdom Best in 1899 and tallies with the description and measurements given by Buck (1924, p. 349) of a "tu-maurea", in the Auckland Museum.

Voucher specimen in the Ethnology collection of the Auckland Institute and Museum:—

Eth. 780 woman's belt made of 11 plaited cords, reddish brown; 86 x 3 cm; with black dyed *Phormium* ties 50 cm long; Urewera, 1899 (Fig. 8).

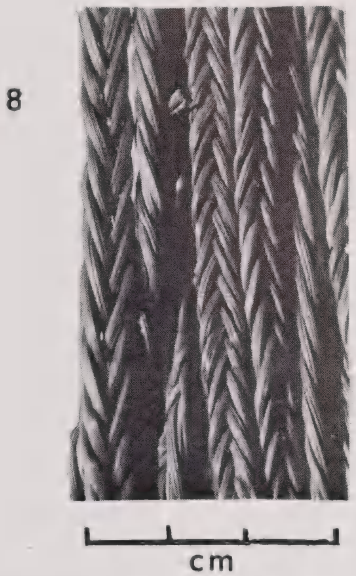


Fig. 8. *Uncinia rubra;* woman's belt, Eth. 780.

Characters for the identification of *Uncinia rubra* in archaeological and ethnological material are:—

(Leaves are not dealt with here as only stems were found in the item described).

Stems erect, rigid, round or bluntly triangular; *c.* 35 cm long x 1 mm diameter; reddish brown.

Outer surface of stem smooth, slightly shiny, ribbed; ribs finely striate; reddish brown.

Inner surface of stem dull, pithy, light brown.

Fibre attached to epidermis, coarse, flat, 0.2 mm wide.

This sedge can be recognized by the reddish colour and the smooth round or sometimes triangular flowering stems which may be scabrid towards the apex.

Fibre-Plants in Literature Only

References are listed here to plants mentioned in the literature as having been used by the Maori. None of these plants have been found in the archaeological or ethnological material available.

Aciphylla sp. (Umbelliferae) spear grass.
sandals — Hamilton 1896 - 1901, p. 293; Best 1899, p. 653; Buck 1924, p. 357.

Asplenium bulbiferum (Aspleniaceae) mauku, hen and chickens.
cloaks — Hamilton 1896 - 1901, p. 290; Best 1899, p. 643.

Carex sp. (Cyperaceae).
belts — Hamilton 1896 - 1901, p. 292; Best 1899, p. 648, 1924b, p. 522; Buck 1923, p. 709, 1924, p. 348.
thatch — Colenso 1868a, p. 34.

Celmisia sp. (Compositae) mountain daisy.
cloaks — Hamilton 1897, p. 175, 1896 - 1901, p. 288.
rain capes — Mead 1969, p. 61.

Chionochloa sp. (Gramineae) tussock.
rain capes — Hamilton 1896 - 1901, p. 281.

Juncus sp. (Juncaceae).
thatch — Colenso 1869a, p. 34.

Leptocarpus similis (Restiaceae) oioi.
thatch — Colenso 1869a, p. 34.

Cyperus ustulatus (Cyperaceae)
kites — Best 1924b, pp. 118, 120, 1924c, p. 139.
thatch — Colenso 1869a, p. 34.

Scirpus lacustris (Cyperaceae) paopao, kutakuta.
(Sometimes confused with *Eleocharis sphacelata* — kutakuta).
mats — Buck 1923, p. 708.

S. maritimus (Cyperaceae)
(In Cheeseman 1925, p. 226).
thatch — Colenso 1869a, p. 34.

Other Plants

As they do not come under the category of fibre-plants, no account has been given here of the stems of vines and ferns, or of aerial roots of plants such as *Metrosideros* and *Freycinetia* used for binding and lashing. Fragments of some vines and ferns have been collected in cave sites, e.g. *Lygodium articulatum* (mangemange) and *Pteridium aquilinum* var. *esculentum* (fern or bracken), and the stems of these plants are seen in eel traps in the Ethnology collections, where *Rhipogonum scandens* (supplejack) is also seen in handles of fishing nets. The bark from *Hoheria* sp. was sometimes made into headbands and in modern times the ribbons of fibre are made into hats and fancy baskets.

Fibres not native to New Zealand were found in the Fiordland material, in fragments of rope and sacking or sailcloth, probably used by the early European sealers. The fibres identified were *Cocos* (Fig. 22), *Cannabis* and *Cochorus*.

Key

A key to the fibre-plant material described above as being found in archaeological and ethnological collections is presented as an aid to identification.

Key to fibre-plant material used by the Maori

1	Material used a stem, finely striate	2
	Material used a leaf, parallel veined	3
2	Stem *c.* 1cm diameter, flattened, pale brown, transversely septate at intervals of up to 12cm	*Eleocharis sphacelata*
	Stem *c.* 1mm diameter, round, reddish brown, not transversely septate	*Uncinia rubra*
3	Midrib absent	4
	Midrib present	6
4	Leaf reddish, fine veins with stomata obvious between, margins sometimes serrulate or crenulate	*Dracophyllum*
	Leaf brownish, fine veins with stomata not obvious between, margins entire	5
5	Leaf light brown, margins thin	*Typha orientalis*
	Leaf yellow-brown, margins ribbed and coloured	*Bulbinella gibbsii* var. *balanifera*
6	Midrib and margins minutely toothed	7
	Midrib and margins not minutely toothed	8
7	Leaf light brown, up to 2.5cm wide	*Freycinetia banksii*
	Leaf bright yellow, 5-8mm wide	*Desmoschoenus spiralis*
8	Veins evenly spaced	9
	Veins not evenly spaced, often 2 or more prominent side veins	10
9	Leaf wide, 5-13cm, smooth; midrib keeled below; margins smooth, coloured	*Phormium*
	Leaf narrow, up to 1.2cm, with minute prickle hairs below; midrib inconspicuous; margins with small prickles, not coloured	*Hierochloe redolens*
10	Midrib apparent above and below	11
	Midrib not apparent above	*Cordyline*
11	Minute prickle hairs between veins below; margins with small prickles	*Cortaderia toetoe*
	No prickle hairs, margins thin, without prickles	12
12	Leaf greenish brown; parallel veins connected by transverse veinlets	*Rhopalostylis sapida*
	Leaf greyish-brown; no transverse veinlets	*Astelia*

Summary and Conclusion

There is evidence in the plant material identified from cave sites in the Auckland Province and from the Fiordland excavations, that the Maori made use of available leaves suitable for his needs of the moment — for temporary baskets and mats, fishing lines and nets. This is apparent in the plaited *Bulbinella* fragments from Fiordland where the plant is abundant. Here too, *Dracophyllum* is plentiful and in archaeological remains portions of leaf were seen as well as fragments of closely plaited material and twine made of one of the "grass trees". A species of *Dracophyllum* may well have been used in the north also, but none was found in the plant remains examined. Colenso claimed that *Dracophyllum* was used for clothing but no examples have been found in the Museum Ethnology collections.

Proof that *Astelia* leaf was used for plaiting in both the North and South Islands can be seen in the remains of baskets found in cave sites at Piha and Taupo, and the plaited leaf and fibre from Fiordland sites — made of different species. There are no such preserved articles in the Ethnology Department at the Museum, but two authors mention *Astelia* as used by the Maori.

Freycinetia leaf and fibre in remains of plaited material were plentiful in collections from the northern sites; whereas from Fiordland only one fragment was seen (of fine plaitwork). In the forest, *Freycinetia* is not so common in the far south. *Rhopalostylis* occurred once, unexpectedly, in the Fiordland material; also only once in the northern sites and once as a basket in the Ethnology Department, although there is evidence in the literature of several Maori uses of this "palm".

A foreseen result was the predominance of *Phormium* leaf and fibre in the plant fragments from both northern and southern localities. Next in order of quantity, from the Auckland Province, was *Freycinetia* followed by *Cordyline* (well represented in many Ethnology specimens). In Fiordland material, *Cordyline* was second to *Phormium,* then *Bulbinella* in surprising amounts.

Identification of the plants used in clothing, mats, baskets and cordage, held in the Ethnology collections of the Auckland Museum may dispel a fairly widespread belief that *all* such Maori articles were made of flax *(Phormium). Cordyline* and *Freycinetia* can be seen in beautifully made rain capes and baskets, and there are more large floor mats of *Freycinetia,* in the Museum, than of *Phormium.* There are also very attractive soft mats and baskets made of the sedge *Eleocharis.*

Some of the old accession labels carried a bare description of the article recorded when acquired by the Museum before the turn of the century; such as "flax mat" or "flax kit", but on recent handling the material was often found to be kiekie, toetoe, nikau or kutakuta. There seems to have been some confusion over the Maori word kutakuta used for two different swamp plants, *Eleocharis sphacelata* and *Scirpus lacustris.* Articles made of *Eleocharis,* but not of the *Scirpus,* have been seen in the Ethnology Department.

Although several authors mentioned the use of *Cortaderia* for thatching and lining houses, for floor mats and kites, only Colenso listed baskets, of which there are two in the Museum collections.

A reddish coloured sedge, *Uncinia rubra,* not recorded in the literature, was

found in a woman's belt in the Museum. Belts made of a reddish sedge were said to be of a *Carex* species.

It is probable that all the plants mentioned by the early authors are to be found in the various museum collections of Maori weaving, plaitwork and cordage. There is little doubt that all these plants, as well as unrecorded ones like *Bulbinella and Uncinia,* will be identified in future work on archaeological plant fragments.

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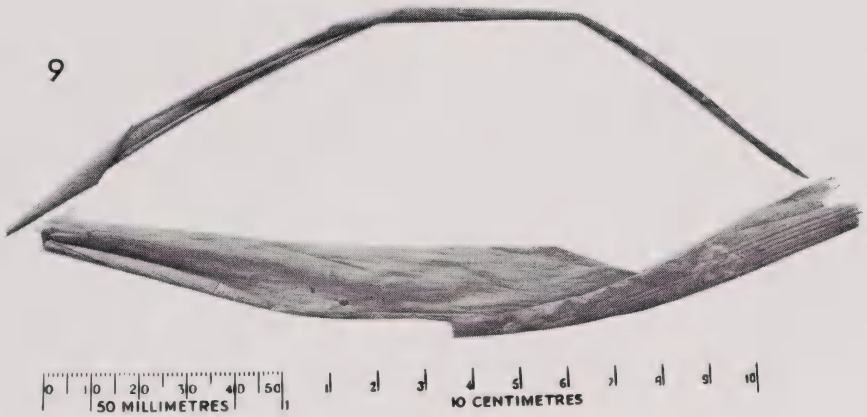
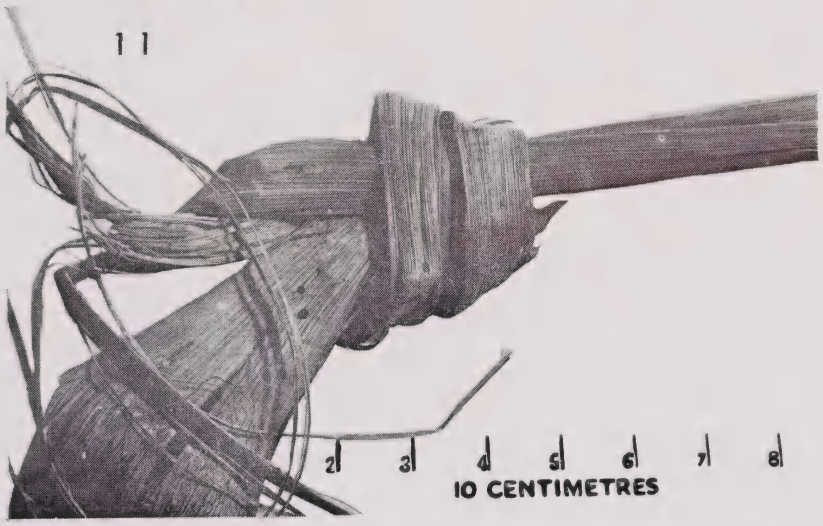
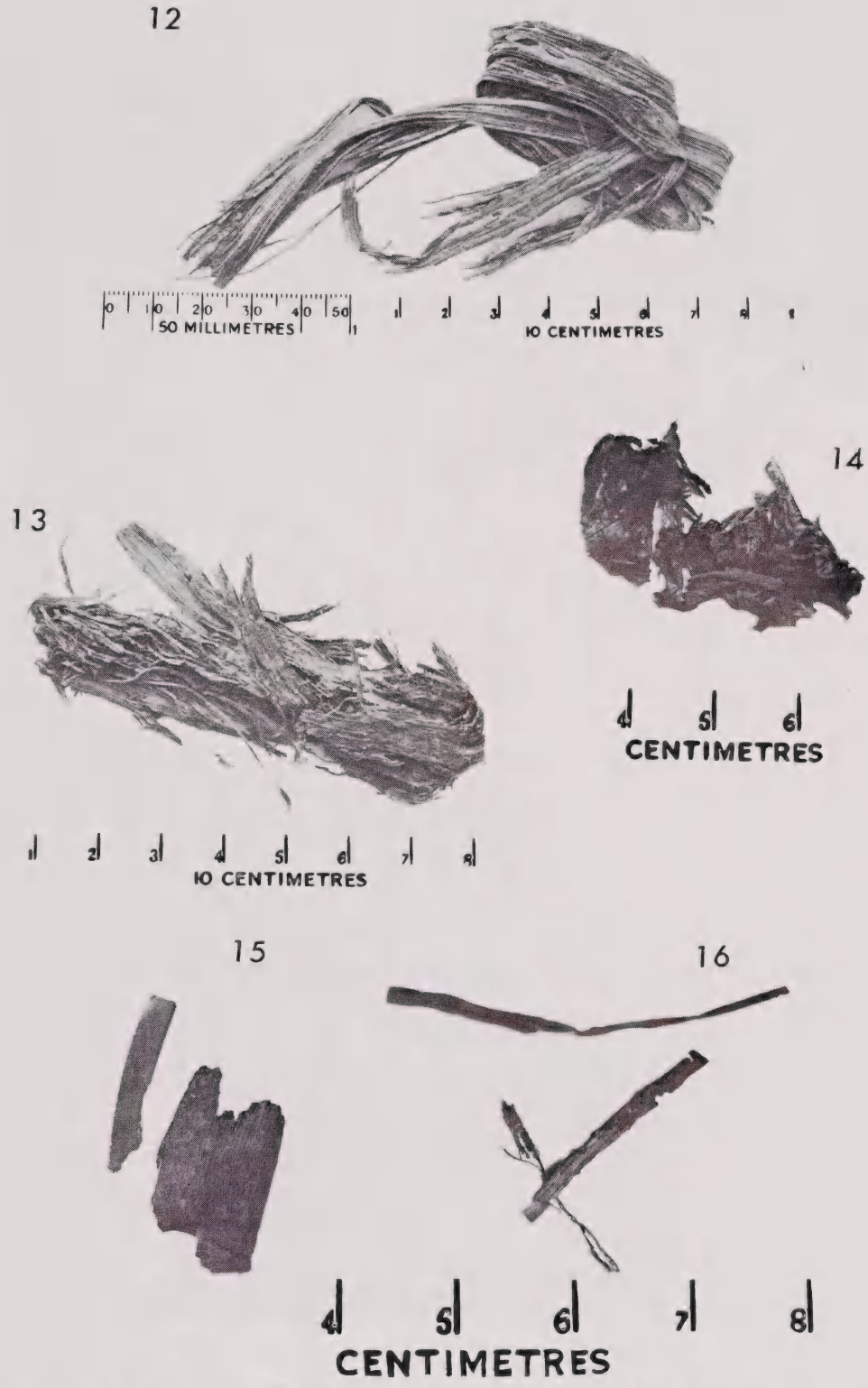
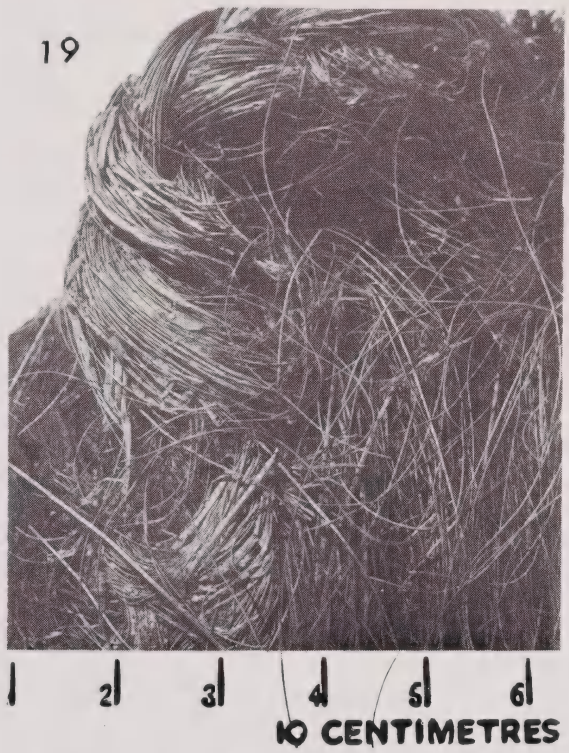




Figs. 9-11. 9. *Bulbinella gibbsii var. balanifera,* Fiordland; remains of leaves, Herb. AK 121858. 10. *Phormium* sp., Fiordland; remains of knotted leaf, Herb. AK 122114. 11. *Cordyline* sp., Anawhata; remains of knotted leaf, Eth. 23887.



Figs. 12-16. 12. *Astelia* sp., Fiordland; remains of knotted leaf, Herb. AK 121856. 13. *Rhopalostylis sapida*, Fiordland; fragment of leaf, Herb. AK 121810. 14. *Phormium* sp., Fiordland; plaited fragment, Herb. AK 126108. 15. *Dracophyllum* sp., Fiordland; fragments of leaf, Herb. AK 122227. 16. *Dracophyllum* sp., Fiordland; fragments of plait, Herb. AK 126106.



Figs. 17-19. *Cordyline sp.* 17. Fiordland; plaited; cordage, Herb AK 122422. 18. Fiordland; remains of leaf, Herb. AK 122115. 19. Poor Knights Islands; bundle of fibre, Eth. 24338.

Figs. 20-22. 20. *Phormium* sp., Fiordland; plaited rope, Herb. AK 122060. 21. *Freycinetia banksii,* Lake Taupo; plaited rope, Eth. 35831. 22. *Cocos* sp., Fiordland; twisted rope, Herb. AK 122438.

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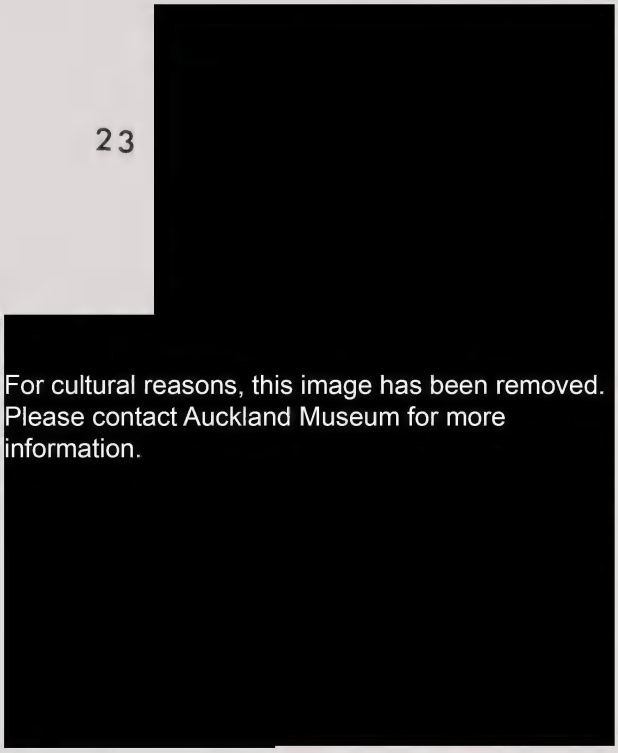

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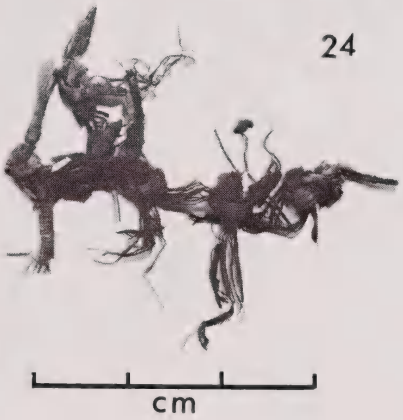

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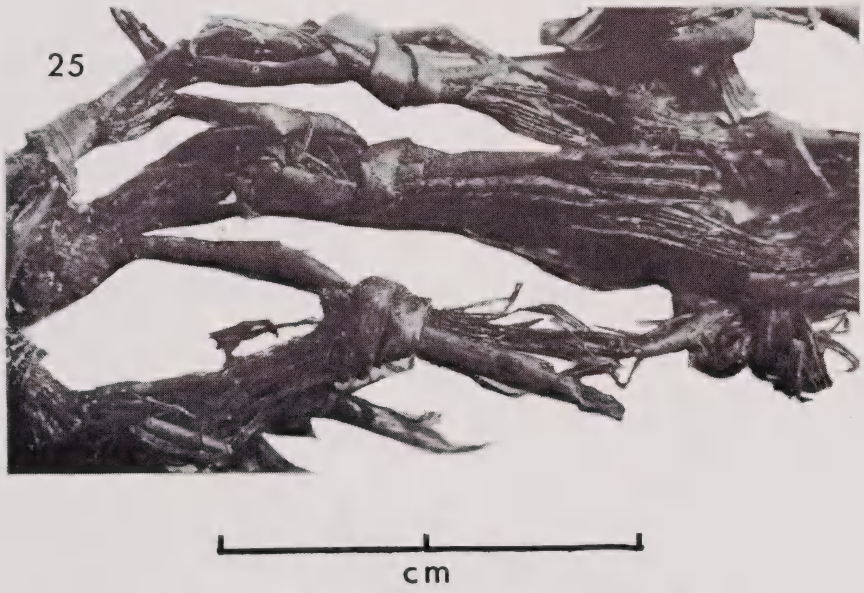
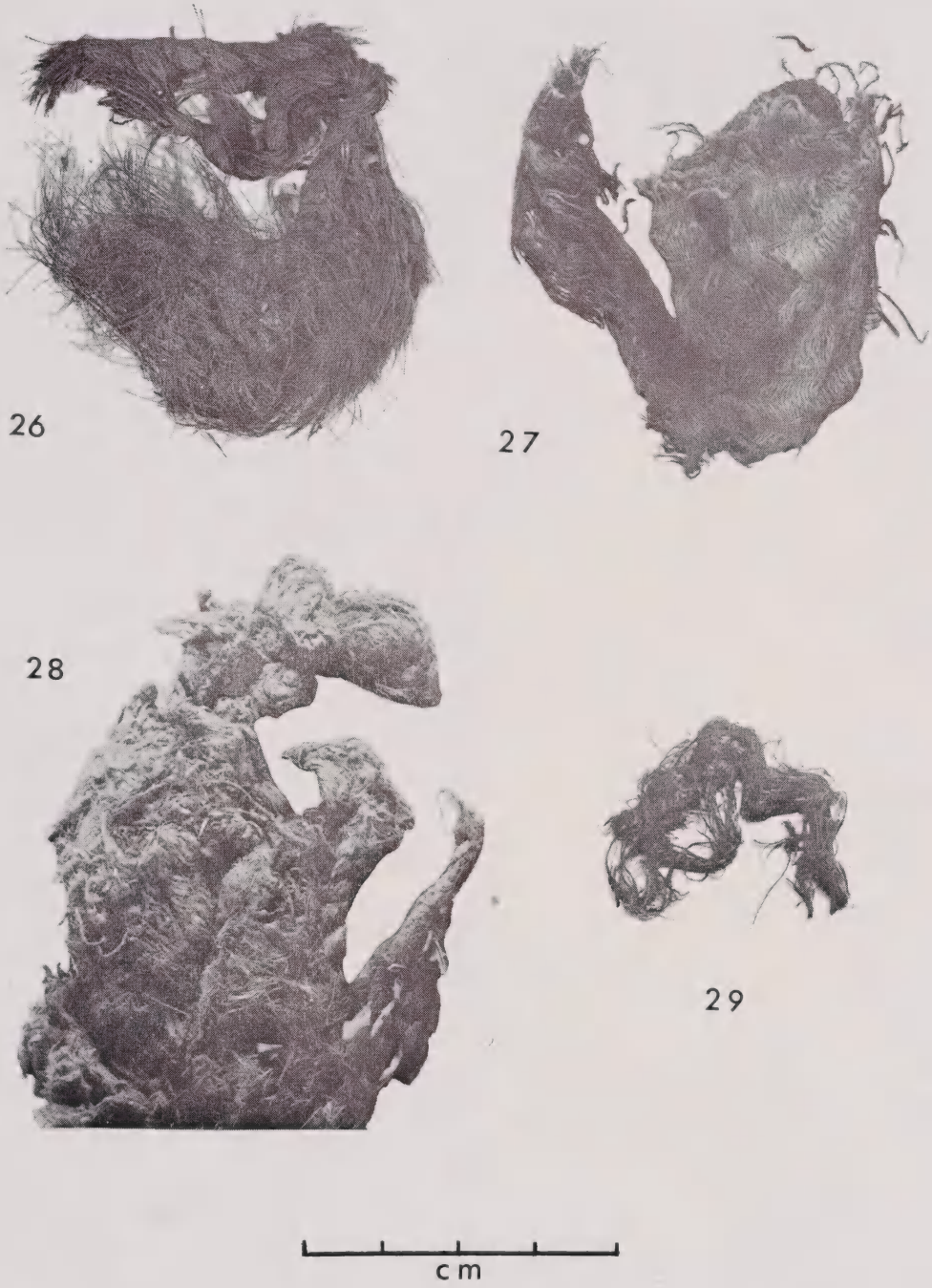


Figs. 23-25. *Phormium sp.* 23. Anawhata; fishing net, Eth. 38819. 24. Fiordland; fragment of net, Herb. AK 121859. 25. Anawhata; remains of net, Eth. 23883.



Figs. 26-29. 26. *Freycinetia banksii,* Anawhata; plaited fibre, Eth. 23887.2. 27. *Phormium* sp., Lake Taupo; fragments of woven cloak, Eth. 34802.1. 28. *Phormium* sp., Anawhata; remains of cape (?), Eth. 23889. 29. *Cordyline* sp., Fiordland; fragment of dressed fibre, Herb. AK 126052.

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Figs. 30-32. 30. *Rhopalostylis sapida,* Anawhata; plaited leaf, Eth. 23887. 31. *Freycinetia banksii,* Piha; fragments of twilled plait, Eth. 19775.4. 32. *Phormium* sp., Lake Taupo; plaited bag, Eth. 35829.

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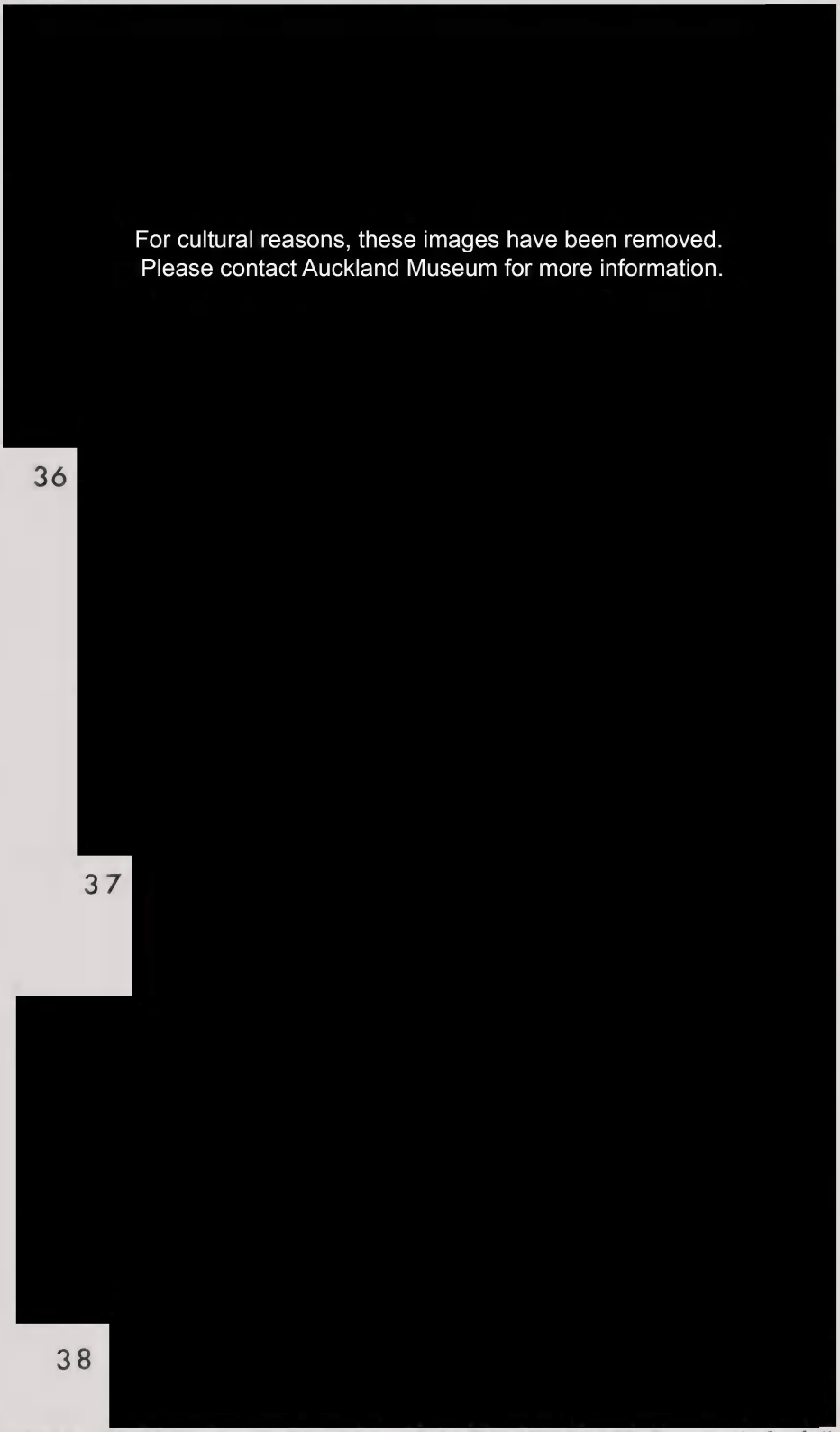
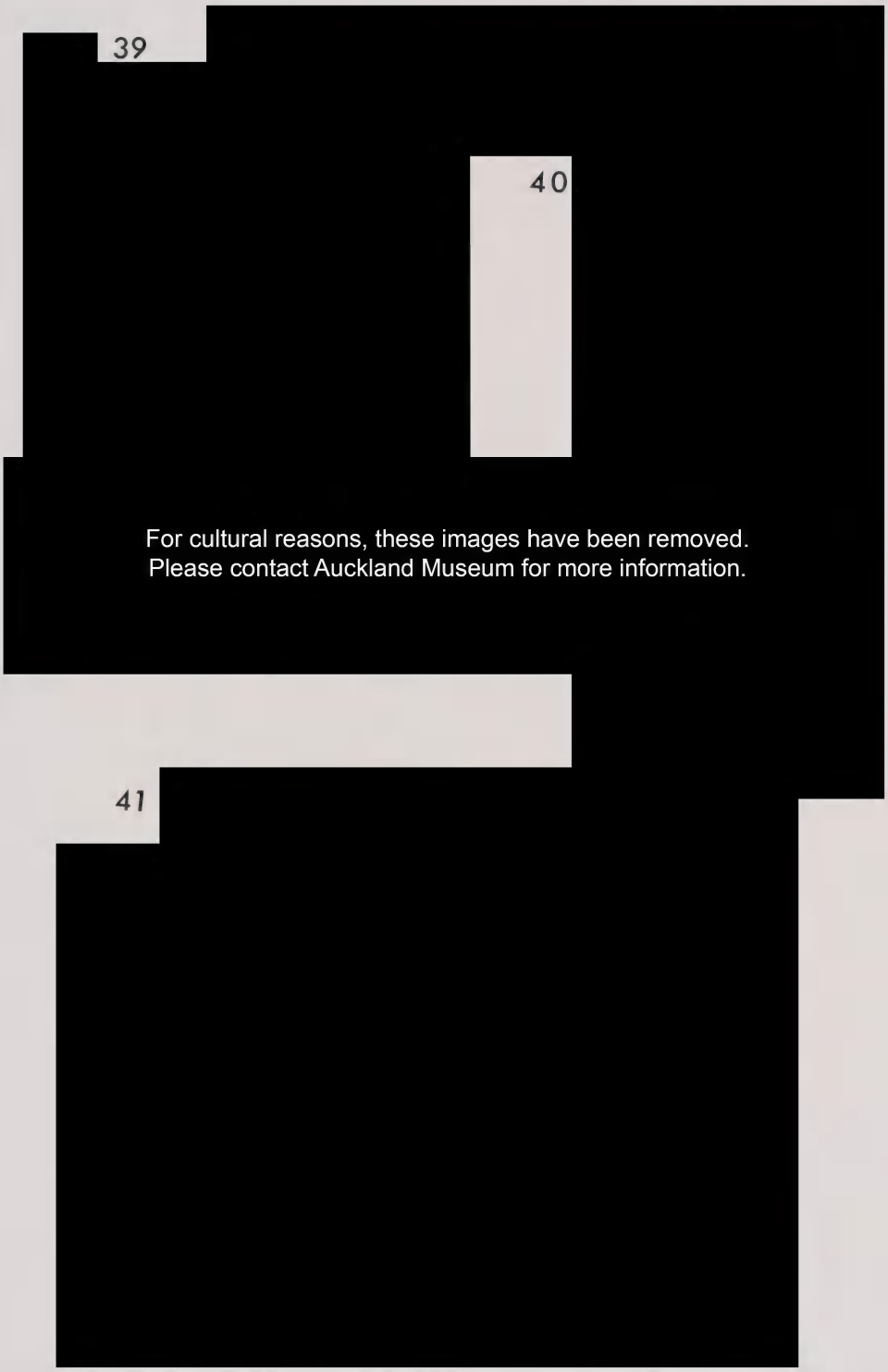
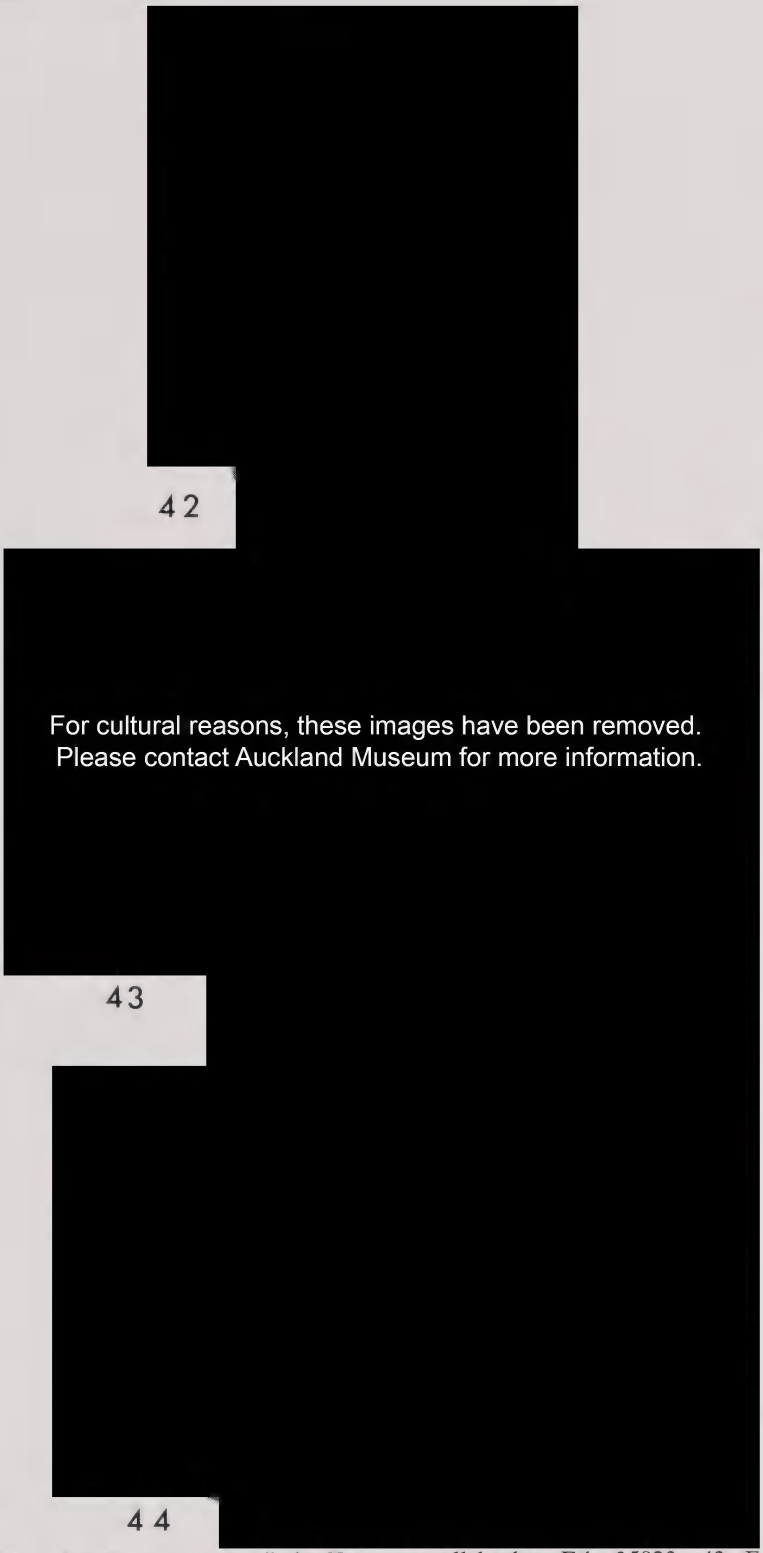
Figs. 33-35. 33. *Cortaderia toetoe,* Piha; remains of plaited basket, Eth. 26448.3. 34. *Astelia* sp., Piha; remains of basket, Eth. 19775.1. 35. *Astelia* ap., Lake Taupo; plaited basket, Eth. 35825.



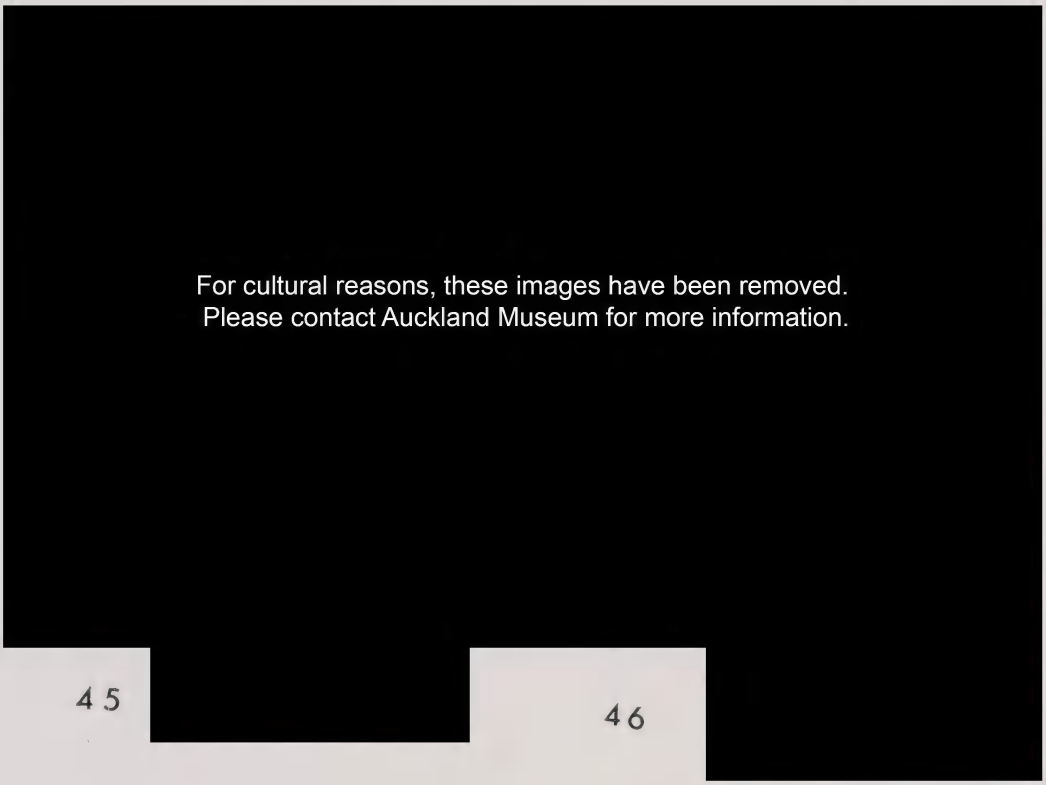
Figs. 36-38. 36. *Phormium* sp., Piha; plaited belt, Eth. 19776.2. 37. *Freycinetia banksii,* Piha; plaited belt, Eth. 19776. 38. *Freycinetia banksii,* plaited belt, Eth. 19483.



Figs. 39-41. 39. *Freycinetia banksii,* Lake Taupo; remains of plaited basket, Eth. 35838. 40. *Freycinetia banksii,* Lake Taupo; remains of plaited belt, Eth. 35827. 41. *Cordyline* sp., Lake Taupo; remains of plaited basket, Eth. 35883.



Figs. 42-44. 42. *Phormium* sp., Lake Taupo; small basket, Eth. 35823. 43. *Freycinetia banksii,* Piha; basket with two handles, Eth. 43127.1. 44. *Phormium* sp., Lake Taupo; woven bag, Eth. 35832.



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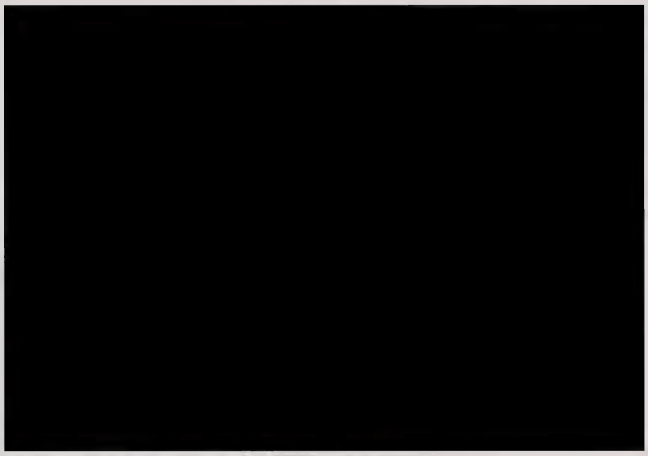
Figs. 45-47. 45. *Phormium* sp., sandal, Eth. 1075. 46. *Cordyline* sp., sandals, Eth. 6180. 47. *Freycinetia banksii,* plaited basket, Eth. 8234.



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For cultural reasons, these images have been removed.
Please contact Auckland Museum for more information.

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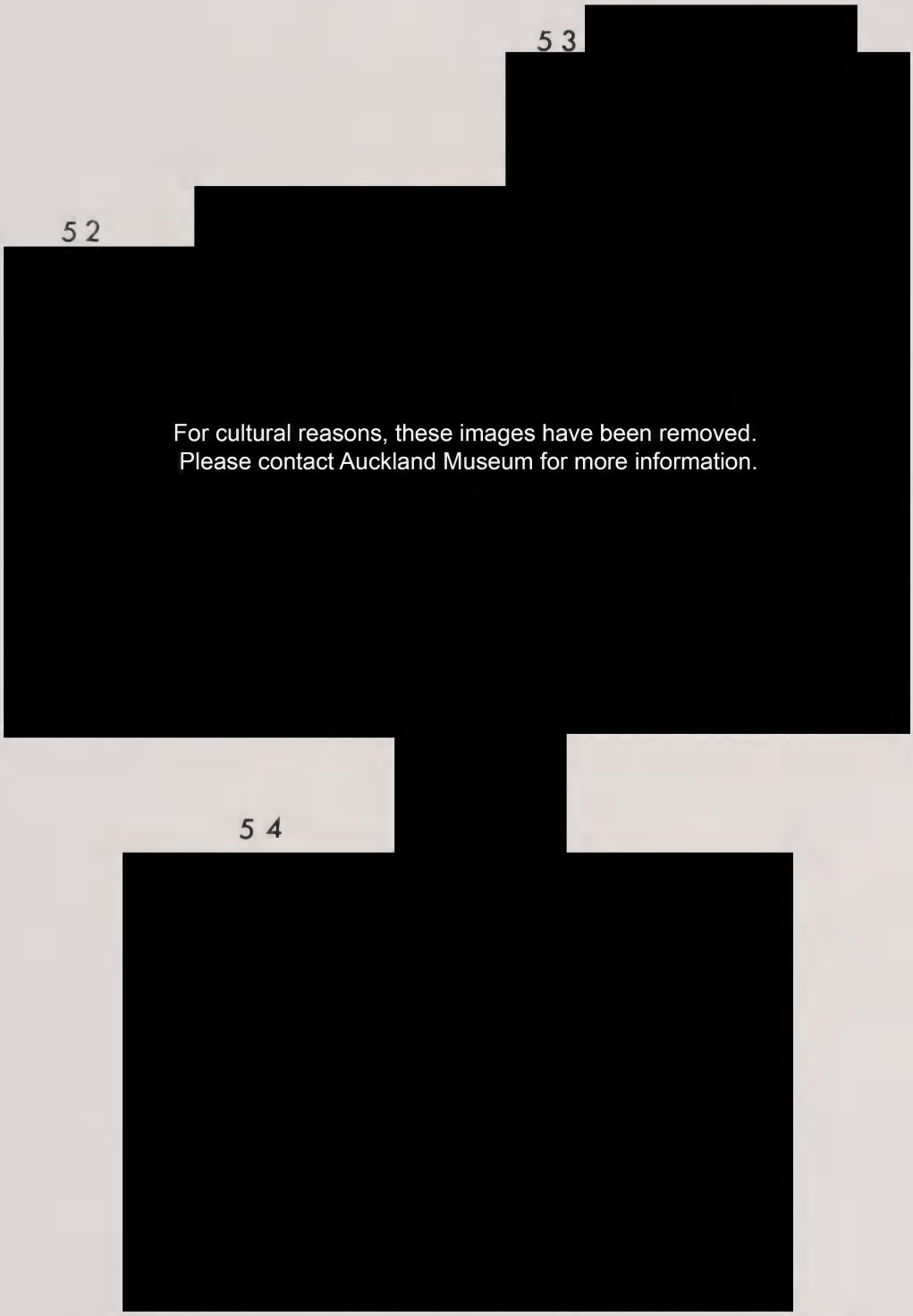
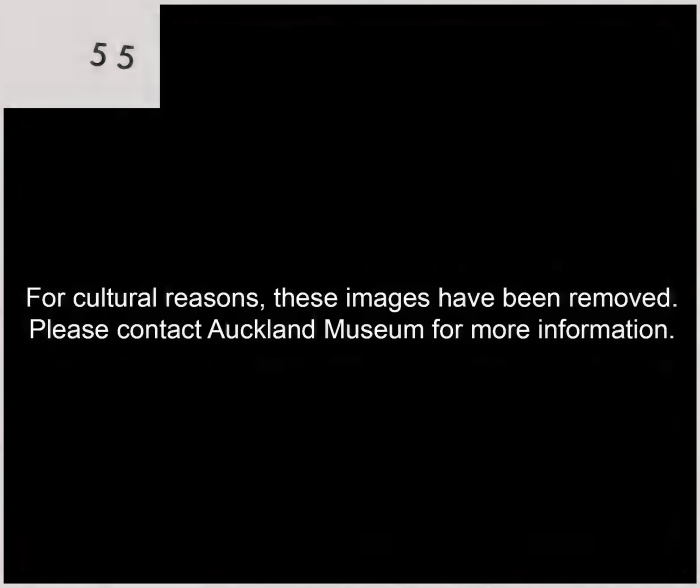
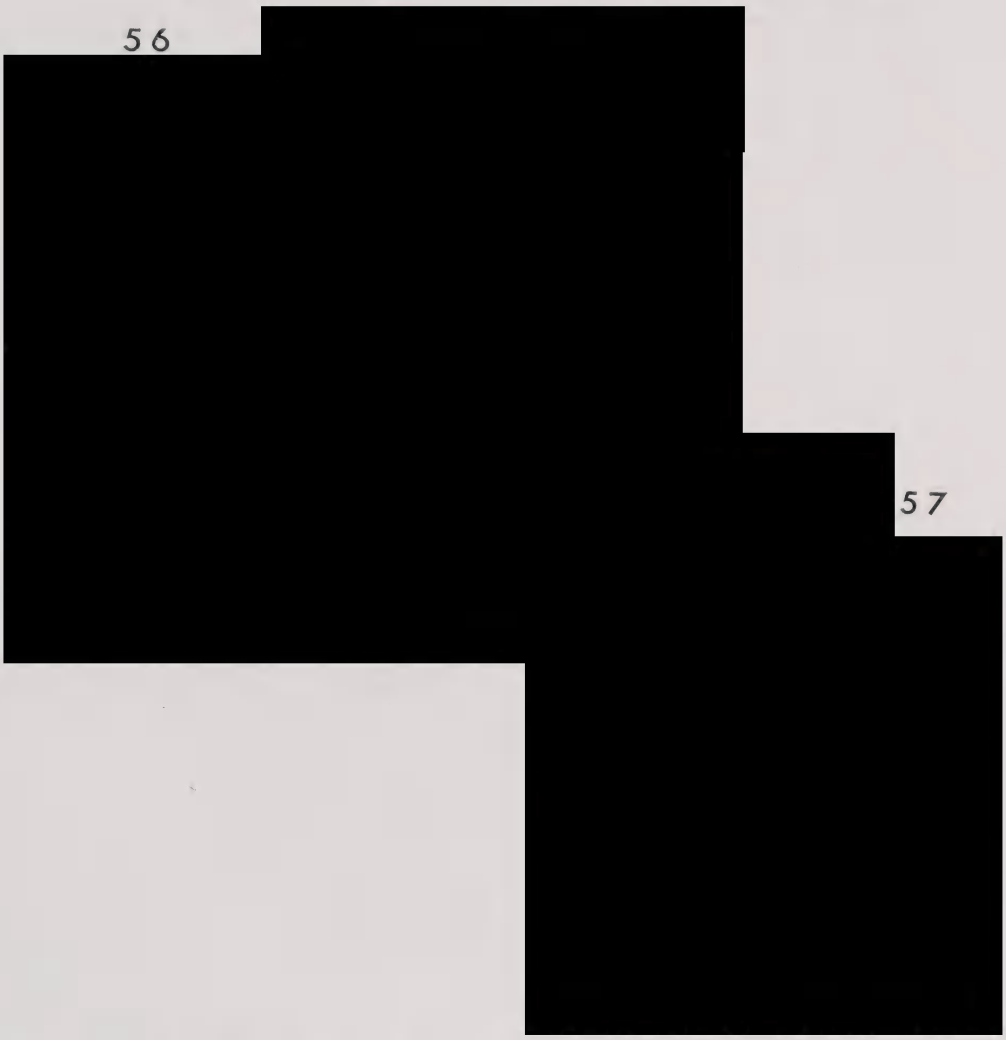
Figs. 48-51. 48. *Desmoschoenus spiralis,* small plaited basket, Eth. 18811. 49. *Eleocharis sphacelata,* small plaited basket, Eth. 6012. 50. *Cordyline* sp., plaited food basket, Eth. 3867. 51. *Phormium* sp., plaited food basket, Eth. 785.

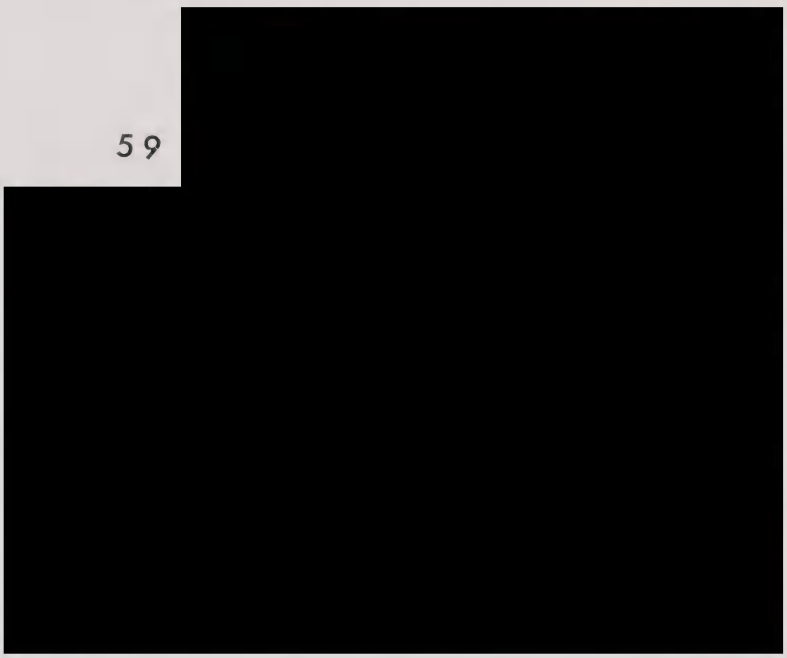


Figs. 52-54. 52. *Cortaderia* sp., plaited cooking basket, Eth. 31052. 53. *Phormium* sp., plaited cooking basket, Eth. 7678. 54. *Freycinetia banksii,* plaited basket, Eth. 8238.

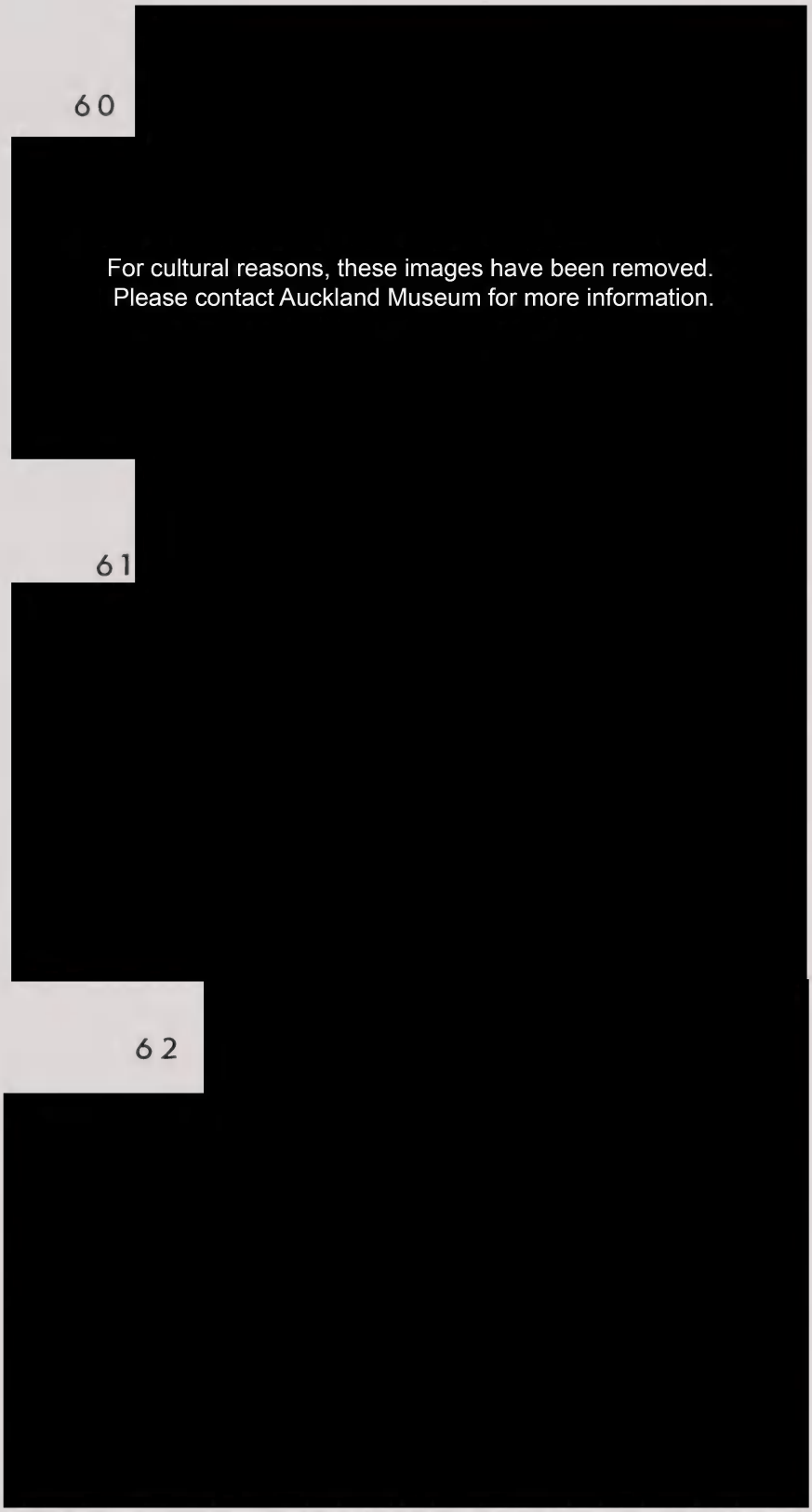




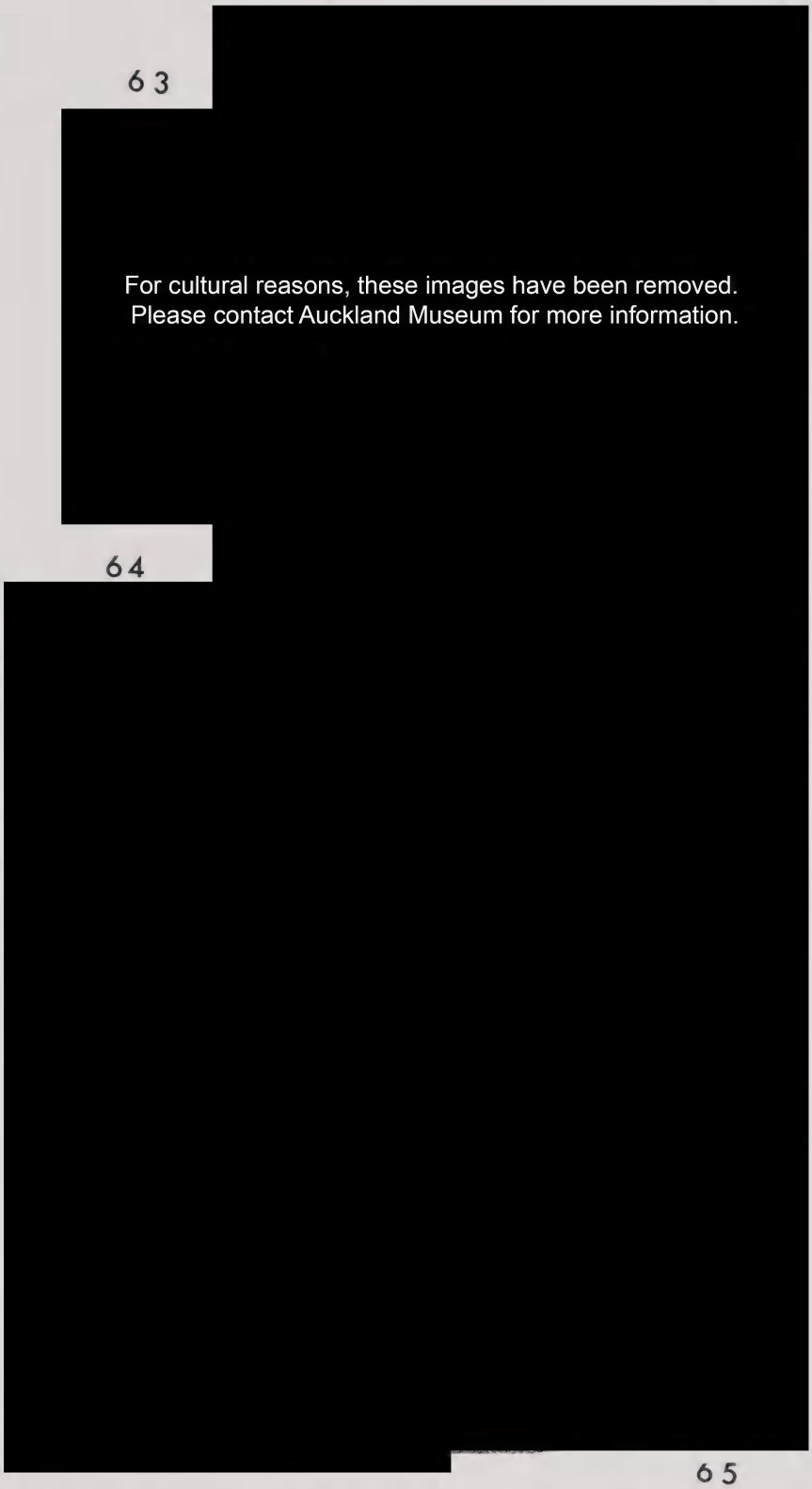
Figs. 55-57. 55. *Eleocharis sphacelata,* plaited basket, Eth. 9229. 56. *Rhopalostylis sapiau,* plaited basket, Eth. 6402. 57. *Phormium* sp., small plaited basket, Eth. 740.



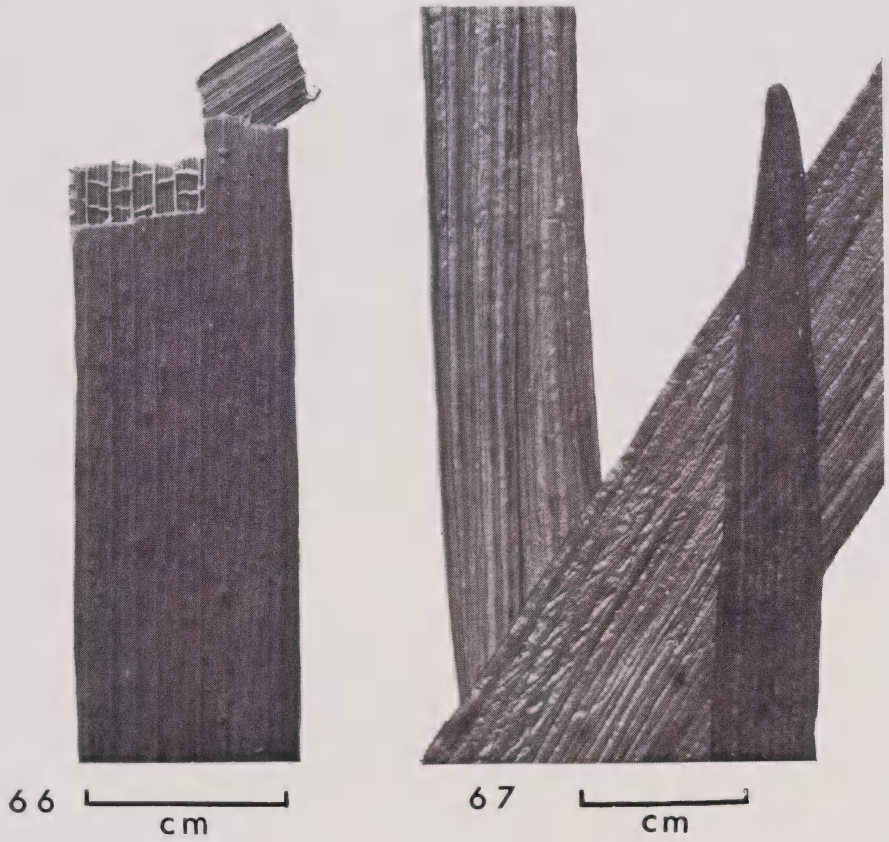
Figs. 58, 59. 58. *Desmoschoenus spiralis* (light colour) with dyed *Phormium,* plaited basket, Eth. 9992. 59. *Freycinetia banksii,* plaited basket, Eth. 660.

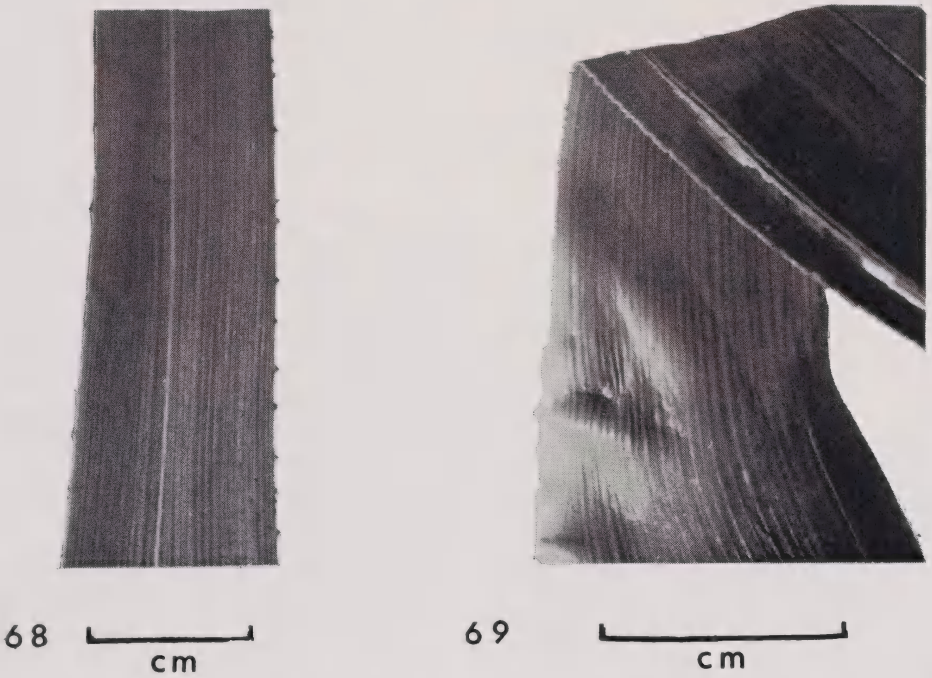


Figs. 60-62. 60. *Phormium* sp., plaited basket, Eth. 13875.1. 61. *Cordyline* sp., plaited basket, Eth. 8229. 62. *Cordyline* sp., plaited basket, Eth. 3865.



Figs. 63-65. 63. *Phormium* sp., plaited basket, Eth. 6874. 64. *Freycinetia banksii,* plaited basket, Eth. 38128.1. 65. *Freycinetia banksii,* plaited basket, Eth. 5003.





Figs. 66-69. 66. *Typha orientalis,* dried herbarium specimen, Herb. AK 119696. 67. *Bulbinella gibbsii* var. *balanifera,* dried herbarium specimen, Herb. AK 14638. 68. *Freycinetia banksii,* dried herbarium specimen, Herb. AK 126982. 69. *Dracophyllum menziesii,* dried herbarium specimen, Herb. AK 25808.

FOSSIL AND RECENT CYPRAEACEA (MOLLUSCA: GASTROPODA) OF NEW ZEALAND WITH DESCRIPTIONS OF NEW SPECIES

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Abstract. The superfamily Cypraeacea is represented in New Zealand by 4 families and 36 species. In the Triviidae, 20 fossil species of Eratoinae and 5 species of Triviinae have been recorded; only one triviid species is found living in New Zealand waters. The Cypraeidae number 5 fossil species two of which are described as new to science, and 2 Recent species are firmly established members of New Zealand's molluscan fauna. Ovulidae are represented by 2 fossil and 1 living species and only 1 species of Pediculariidae occurs living in northern New Zealand waters.

Superfamily CYPRAEACEA Rafinesque, 1815

1863. Triviacea Troschel, Geb. Schnecken 1:214.
1966. Triviacea Troschel, Schilder, Veliger 9(1): 31,33.

Family TRIVIIDAE Troschel, 1863

1932. Eratoidae Schilder, Proc. Malac. Soc. Lond. 20:46.

Shell small or very small, elongate-ovate, ovate or conical, sometimes inflated, aperture linear or oblique, central or lateral, dentate on both lips; spire immersed or projecting, fossula either connected to the dorsal wall or free. Smooth or sculptured with transverse ribs and granules, dorsum with or without a dorsal groove; periostracum and operculum absent.

The osphradium is bipectinate, pedal ganglia are ovoid and short, and the echinospira larva is well developed. The living animal extends the mantle over the shell and moves freely on the substratum; the sipho is distinct and sexes are separate. The marginal teeth of the radula are claw-like and simple, the inner marginal occasionally with a small denticle. Triviidae live on a coral and rock substratum.

Fretter and Graham (1962) assigned the Triviidae to the superfamily Lamellariacea d'Orbigny, while Schilder (1966) located the family in the superfamily Triviacea. In Lamellariacea the shell is sometimes internal, and when external it is ear-shaped, with a large aperture, a sharp labial lip and a smooth columella. Lamellariidae have a periostracum, a nautiloid echinospira larva, ovoid pedal ganglia, united jaws and no distinct sipho; species of one genus are hermaphrodite. Triviidae are more closely related to the Cypraeacea and differ from Cypraeidae and Ovulidae which have no echinospira larva, long pedal ganglia and a triradiate osphradium.

Rec. Auckland Inst. Mus. 8: 103-129 December 17th 1971

From a phylogenetic viewpoint, Eratoinae and Triviinae are closely related and the anatomy of both groups is also rather similar. Fretter & Graham (loc. cit.), Schilder (1966) and Cernohorsky (1968) have combined Eratoinae and Triviinae in one family.

Subfamily ERATOINAE Gill, 1871

1871. Eratoinae Gill. Smiths. Misc. Coll. 10(227) : 9.
1927. Eratoinae Schilder, Arch. Naturg. 91 :1.

Shell small, biconic, marginellid in shape, spire broad and projecting, sometimes calloused, aperture more or less angulate, sometimes oblique. Smooth or sculptured with granules or short ribs and occasionally a dorsal groove; aperture moderately narrow, both lips dentate and shell outlets broad and shallow. Sipho separated by a rim and anterior margin of fossula free.

The subfamilial name Eratoinae should be credited to Gill (1871) and not Schilder.

Genus **Willungia** Powell, 1938

Willungia Powell. 1938, Trans. Proc. R. Soc. N.Z. 68(3) : 370. Type species by OD *W.tasmanica* Powell, 1938. L.Miocene of Tasmania, Australia.

Shell globular and inflated, protoconch with 1½ whorls, spire depressed, labial varix calloused; aperture open, occasionally widening anteriorly, labial lip regularly convex and ribbed, columella with prominent ribs along its entire length, ribs extending onto body whorl. Columella excavated anteriorly and with a strong single terminal fold; fossula weak but broad and ridged.

Three New Zealand species are referable to this genus. *Willungia* is probably the most primitive eratoid aand resembles to some extent *Eratotrivia* Sacco from the European Eocene, particularly the species *E.wetherellii* Edwards from the Lower Eocene of England. In *Eratotrivia,* however, the columellar ribs are continuous and encircling, and the anterior columellar projection is lacking.

Willungia erro (Laws, 1941) (Fig. 1)

1941. *Eratopsis erro* Laws, Trans. Proc. R. Soc. N.Z. 71 (2) : 144, pl. 18, fig. 24.
1966. *Eratopsis erro* Laws, Fleming, N.Z. Geol. Surv. Bull. No. 173 :53.

TYPE LOCALITY: Pakaurangi Point, Kaipara, (Otaian), L.Miocene.

This species is a typical *Willungia* although more slender than the type species.

Willungia fracta (Tomlin, 1916) (Fig. 2)

1873. *Marginella ventricosa* Hutton, Cat. Tert. Moll. Echin. N.Z. p. 8 (non G. Fischer, 1807).
1916. *Marginella fracta* Tomlin, J. Conch. 15 :43 *(nom. subst. pro M.ventricosa* Hutton, 1873).
1938. *Willungia fracta* (Tomlin), Powell, Trans. Proc. R. Soc. N.Z. 68 (3) : 371, pl. 39, figs. 6, 7 (Waiheke I., L. Miocene).

Figs. 1, 2. 1. *Willungia erro* (Laws). Pakaurangi Pt, L. Miocene; length 5.9mm. (from Laws, 1941, pl. 18, fig. 24). 2. *W. fracta* (Tomlin). Whitewater Creek, Trelissick Basin, U. Oligocene; length 18.0mm.

TYPE LOCALITY: Broken River, (Duntroonian), U.Oligocene.

Schilder (1961) suggested a placement of this species into *Archierato*. *Marginella fracta* is a *Willungia*, and in the figured specimen from Trelissick Basin, 8 plications are visible which cross the ventral side of the body whorl.

Willungia maoria Powell, 1938

1938. *Willungia maoria* Powell, Trans. Proc. R. Soc. N.Z. 68(3) : 371, pl. 39, figs. 8,9.
1966. *Willungia maoria* Powell, Fleming, N.Z. Geol. Surv. Bull. No. 173 :53.

Schilder (1961) suggested that *Willungia maoria* be placed in *Archierato*. The holotype of *W.maoria* is indeed a *Willungia*, but due to breakage, fossilization and distortion, some characters may not be evident from the type figure. The labial denticles are elongated ridges, but due to distortion have been displaced deep into the aperture; possibly not being a fully developed individual or due to wear, the overlapping columellar ridges are not evident on the ventral side of the body whorl.

Genus **Lachryma** Sowerby [1832]

Lachryma Sowerby [1832], Conch. Illust. Cat. Cypr., p. 15. Type species by T *Erato lachryma* Sowerby, [1832]. Recent, S.E. Australia.

1932. *Cypraeerato* Schilder, Fossil. Cat. p. 86. Type species by OD *Erato bimaculata* Tate. 1878. Recent, Sth. Australia.

1935. *Eratoena* Iredale, Aust. Zool. 8 :97. Type species by OD *Ovulum corrugatum* Hinds, 1845 = *Erato sulcifera* Sowerby, [1832]. Recent, Indo-Pacific.

Shell very small, biconic, smooth or granulose, occasionally with a dorsal groove, spire broad and projecting, labial lip convex and slightly reflected; aperture lateral, narrow and oblique, lips dentate, posterior columellar denticles often obsolete, fossula moderately concave. Anterior of columellar lip with 2-3 stronger plications not separated from the columellar denticles. Unicoloured or banded, anterior extremity often violet.

The priority of the genus-group name *Lachryma* Sowerby over *Proterato* Schilder, has been discussed by the present author already (Cernohorsky 1968). Article 11(d) of the Code of I.C.Z.N. is quite explicit about names published in synonymy, and *Lachryma* is clearly an available and prior genus name since it has been treated as an available name with its original date and authorship prior to 1961 by several writers. The name *Lachryma* was used by Iredale (1931), Cotton & Godfrey (1932), Iredale (1935), Cotton (1958), Allan (1959) and Cotton (1959); after 1961 it has been used by Iredale & McMichael (1962) and Cernohorsky (1968).

Lachryma will replace *Proterato* Schilder as a genus, and will include Recent Indo-Pacific species previously placed in either *Sulcerato* Finlay or *Eratoena* Iredale. *Proterato* Schilder has been retained as a subgenus for a group of Eocene-Pliocene fossil species from New Zealand and Australia.

Subgenus **Proterato** Schilder, 1927

Proterato Schilder, 1927, Arch. Naturg. 91A : 57. Type species by OD *Erato neozelanica* Suter, 1917. L.Miocene of New Zealand.

1930. *Sulcerato* Finlay, Trans. Proc. N.Z. Inst. 61(1) : 40. Type species by OD *Erato (Eratopsis)illota* Tate, 1890. L.Pliocene of Victoria, Australia.

Species of *Proterato* differ from *Lachryma* s.str. only in the absence of surface sculpture and a slightly deeper and more produced fossula. Species of *Proterato* are confined to Eocene-Pliocene deposits of Australia and New Zealand.

Eocene species

Lachryma (Proterato) antiqua (Marshall, 1919)

1919. *Erato antiqua* Marshall, Trans. Proc. N.Z. Inst. 51 :227, pl. 15, fig. 7.

1933. *Archierato antiqua* Marshall, Schilder, Proc. Malac. Soc. Lond. 20 (5) : 260.

1935. *Erato antiqua* Marshall, Laws, Trans. Proc. Soc. N.Z. 65(1) : 18.

1941. *Proterato (Proterato) antiqua* Marshall, Schilder, Arch. Moll. 73 : 68.

1966. *Archierato antiqua* (Marshall), Fleming, N.Z. Geol. Surv. Bull. No. 173 :52.

TYPE LOCALITY: Hampden beds, Oamaru (Bortonian), M.Eocene.

The species was assigned to *Archierato* by Schilder (1933) on the basis of the poor type figure. Pertinent additions to the description by Laws (1935), i.e. the numerous labial denticles and 2 light folds on the anterior of the columella, exclude the species from *Archierato*. Species of the latter genus have a single prominent terminal ridge which is well separated from the preceding columellar denticles.

Lachryma (Proterato) seposita (Laws, 1935)

1935. *Erato sepositum* Laws, Trans. Proc. R. Soc. N.Z. 65 (1) : 22, pl. 3, fig. 8.

1941. *Proterato (Proterato) seposita* Laws, Schilder, Arch. Moll. 73 :69.

1966. *Proterato sepositum* (Laws), Fleming, N.Z. Geol. Surv. Bull. No. 173 :53.

TYPE LOCALITY: Greensands, McCullough's bridge, (Kaiatan), U.Eocene.

Lachryma (Proterato) vulcania (Marwick, 1926)

1926. *Erato vulcania* Marwick, Trans. Proc. N.Z. Inst. 56 : 314, pl. 72, fig. 25.
1933. *Proterato (Proterato) vulcania* Marwick, Schilder, Proc. Malac. Soc. Lond. 20(5) : 248.
1935. *Erato vulcania* Marwick, Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 19.
1966. *Proterato vulcania* (Marwick), Fleming, N.Z. Geol. Surv. Bull. No. 173 :53, pl. 90, fig. 1070.

TYPE LOCALITY: Lorne, near Oamaru, (Kaiatan), U.Eocene.

The species differs from other Eocene species by its pyriform shape and weakly developed labial denticles; the columellar teeth are also weak and confined to the anterior third of the columella.

Oligocene — Miocene species

Lachryma (Proterato) marshalli (Marwick, 1929)

1929. *Erato marshalli* Marwick, Trans. Proc. N.Z. Inst. 59(4) : 922, fig. 56.
1933. *Proterato (Proterato) marshalli* Marwick, Schilder, Proc. Malac. Soc. Lond. 20(5) : 248.
1935. *Erato marshalli* Marwick, Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 21.
1941. *Proterato (Cypraeerato) marshalli* Marwick, Schilder, Arch. Moll. 73 :69.
1966. *Proterato marshalli* (Marwick), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52, pl. 90, fig. 1069.

TYPE LOCALITY: Chatton, 8 miles (12.8 km) N. of Gore, Southland, (Duntroonian), U.Oligocene.

Lachryma (Proterato) waitakiensis (Laws, 1935)

1935. *Erato waitakiensis* Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 20, pl. 3, fig. 2.
1941. *Proterato (Eratoena) waitakiensis* Laws, Schilder, Arch. Moll. 73 :69.
1966. *Proterato waitakiensis* (Laws), Fleming, N.Z. Geol. Surv. Bull. No. 173 :53.

TYPE LOCALITY: Otiake, (Waitakian), L.Miocene.

Lachryma (Proterato) neozelanica (Suter, 1917) (Fig. 3)

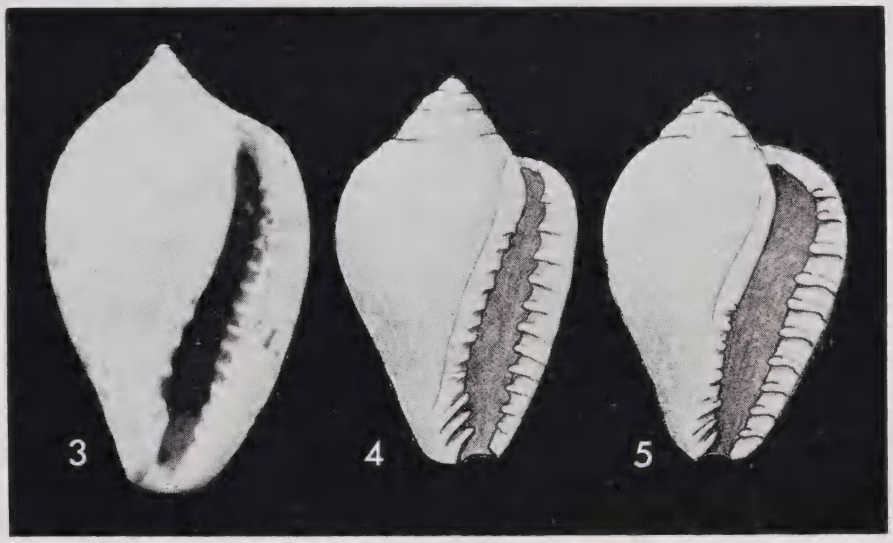
1917. *Erato neozelanica* Suter, N.Z. Geol. Surv. Pal. Bull. 5 :12, pl. 3, figs. 6,7.
1933. *Proterato (Proterato) neozelanica* Suter, Schilder, Proc. Malac. Soc. Lond. 20 (5) : 247, 248. fig. 11.
1935. *Erato neozelanica* Suter, Laws, Trans. Proc. R. Soc. N.Z. 65 (1) : 22.
1966. *Proterato neozelanica* (Suter), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 53.

TYPE LOCALITY: Target Gully, Oamaru, (Awamoan), L.Miocene.

This species is the type species of *Proterato* Schilder, 1927.

Lachryma (Proterato) senectus (Murdoch, 1924) (Fig. 5)

1924. *Erato senectus* Murdoch, Trans. Proc. N.Z. Inst. 55 : 160, pl. 10, figs. 5,6.



Figs. 3-5. 3. *Lachryma (Proterato) neozelanica* (Suter). Devil's bridge, Oamaru, L. Miocene; length 14.6mm. 4. *L. (P.) awamoana* (Schilder) (= *senectus* Murdoch). Awamoa stream, near Oamaru, L. Miocene; length 11.0mm. (from Murdoch, 1924, pl. 10, fig. 4). 5. *L. (P.) senectus* (Murdoch). Target Gully, Oamaru, L. Miocene; length 4.5mm (from Murdoch, 1924, pl. 10, fig. 5).

1933. *Proterato (Cypraeerato) minor senectus* Murdoch, Schilder, Proc. Malac. Soc. Lond. 20(5) : 248, fig. 28.

1935. *Erato senectus* Murdoch, Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 19.

1951. *Proterato (Eratoena) senectus* Murdoch, Schilder, Arch. Moll. 73 : 69.

1966. *Proterato (Cypraeerato) senectus* (Murdoch), Fleming, N.Z. Geol. Surv. Bull. No. 173 :53.

TYPE LOCALITY: Target Gully, Oamaru, (Awamoan), L.Miocene.

Lachryma (Proterato) awamoana (Schilder, 1933) (Fig. 4)

1924. *Erato neozelanica* Murdoch, Trans. Proc. N.Z. Inst. 55 : 160, pl. 10, fig. 4 (non Suter, 1917).

1933. *Proterato (Proterato) awamoana* Schilder, Proc. Malac. Soc. Lond. 20(5) : 248, 260, fig. 10 (*nom. nov. pro. Erato neozelanica* Murdoch, 1924).

1941. *Proterato awamoana* Schilder, Arch. Moll. 73: 69.

1966. *Proterato awamoana* Schilder, Fleming, N.Z. Geol. Surv. Bull. No. 173: 52.

TYPE LOCALITY: Awamoa stream, near Oamaru, (Awamoan), L.Miocene.

This species appears to be a synonym of *L.(P.) senectus* (Murdoch) from the same horizon, and differs only in being larger in size (type of *senectus* 4.5 mm, type of *awamoana* 11.0mm). The figured type of *L. (P.) awamoana* has 3-4 more labial denticles, but this particular character is variable in Eratoinae; in his description of *L. (P.) senectus,* Murdoch (1924) described the labial lip as having few or numerous denticles. Despite the two species close specific resemblance, Schilder (1933) assigned *L. (P.) senectus* to the subgenus *Cypraeerato* and *L. (P.) awamoana* to the subgenus *Proterato;* in 1941 that author transferred *L. (P.) senectus* to the subgenus *Eratoena.*

Lachryma (Proterato) submorosa (Laws, 1935)

1935. *Erato submorosa* Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 20, pl. 3, fig. 4.
1941. *Proterato (Eratoena) submorosa* Laws, Schilder, Arch. Moll. 73 : 69.
1966. *Proterato (Cypraeerato) submorosa* (Laws), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 53.

TYPE LOCALITY: Pukeuri, (Awamoan), L.Miocene.

Lachryma (Proterato) pukeuriensis (Laws, 1935)

1935. *Erato pukeuriensis* Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 21, pl. 3, fig. 6.
1941. *Proterato (Proterato) pukeuriensis* Laws, Schilder, Arch. Moll. 73 : 69.
1966. *Proterato pukeuriensis* (Laws), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 53.

TYPE LOCALITY: Pukeuri, (Awamoan), L.Miocene.

Lachryma (Proterato) tenuilabrum (Laws, 1935)

1935. *Erato tenuilabrum* Laws, Trans. Proc. R. Soc. N.Z. 65 (1) : 21, pl. 3, fig. 5.
1941. *Proterato (Proterato) tenuilabrum* Laws, Schilder, Arch. Moll. 73 :69.

TYPE LOCALITY: Clifden, Southland, band 6C, M.Miocene.

This may be a synonym of *L. (P.) pukeuriensis*. The differences noted by Laws (1935), i.e. more excavated columella and a more squat body whorl, point to an immature specimen.

Lachryma (Proterato) waiauensis (Laws, 1935)

1935. *Erato waiauensis* Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 22, pl. 3, fig. 7.
1941. *Proterato (Proterato) waiauensis* Laws, Schilder, Arch. Moll. 73 : 69.
1966. *Proterato waiauensis* (Laws), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 53.

TYPE LOCALITY: Clifden, Southland, beds A and C. M.Miocene.

Lachryma (Proterato) clifdenensis (Laws, 1935)

1935. *Erato clifdenensis* Laws, Trans. Proc. R. Soc. N.Z. 65(1) : 20, pl. 7, fig. 3.
1941. *Proterato (Eratoena) clifdenensis* Laws, Schilder, Arch. Moll. 73 :69.
1966. *Proterato clifdenensis* (Laws), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.
TYPE LOCALITY: Clifden, Southland, band 7, (Lillburnian), M.Miocene.

Pliocene species

Lachryma (Proterato) pliocenica (Fleming, 1943)

1943. *Proterato pliocenica* Fleming, Trans. Proc. R. Soc. N.Z. 73(3) : 196, pl. 29, fig. 10.
1966. *Proterato pliocenica* Fleming, N.Z. Geol. Surv. Bull. No. 173 : 53.

TYPE LOCALITY: Takapau S.D., (Waitotaran), U.Pliocene.

This species is the youngest *Proterato* on record from New Zealand.

Genus **Archierato** Schilder, 1932

Archierato Schilder, 1932, Fossil. Cat., p. 82. Type species by OD *Erato pyrulata* Tate, 1890. Aldingian and Adelaide bore, U.Eocene of Sth. Australia.

Shell more inflated and pear-shaped than *Proterato*, sometimes globular, extremities more rounded, spire hidden or visible, labial denticles generally coarser, posterior columellar teeth obsolete, anterior ones small; base of columella with a single, strong terminal fold, fossula concave, often narrow.

The shell figured by Powell (1938) as *Cypraea ovulatella* Tate, from the Aldingian Eocene of South Australia, appears to be a variant of *Archierato pyrulata* (Tate, 1890) in which the labial teeth are more distant. The actual *Cypraea ovulatella* Tate belongs to the cypraeid genus *Austrocypraea* Cossman; the species has been figured by Schilder (1935).

Archierato accola (Laws, 1935)

1935. *Erato accola* Laws. Trans. Proc. R. Soc. N.Z. 65(1) : 18, pl. 3, fig. 1.
1941. *Archierato accola* Laws, Schilder, Arch. Moll. 73 :70.
1966. *Archierato accola* (Laws), Fleming, N.Z. Geol. Surv. Bull. No. 173 :52.

TYPE LOCALITY: McCullough's bridge, (Kaiatan), U.Eocene.

Archierato simulacrum Laws, 1939

1939. *Archierato simulacrum* Laws, Trans. Proc. R. Soc. N.Z. 68(4) : 490, pl. 64, fig. 36.
1941. *Proterato (Eratoena) simulacrum* Laws, Schilder, Arch. Moll. 73 :69.
1966. *Archierato simulacrum* Laws, Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.

TYPE LOCALITY: Pakaurangi Point, Kaipara, (Otaian), L.Miocene.

Archierato zepyrulata Laws, 1939 (Fig. 6)

1939. *Archierato zepyrulata* Laws, Trans. Proc. R. Soc. N.Z. 68(4) : 490, pl. 64, fig. 35.
1941. *Archierato zepyrulata* Laws, Schilder, Arch. Moll. 73 :69.
1941. *Hespererato zevitellina* Laws, Trans. Proc. R. Soc. N.Z. 71(2) : 144, pl. 19, fig. 37.
1966. *Archierato zepyrulata* Laws, Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.
1966. *Hesperato* (sic) *zevitellina* Laws, Fleming, N.Z. Geol. Surv. Bull. No. 173 : 53.

TYPE LOCALITY: Pakaurangi Point, Kaipara, (Otaian), L.Miocene *(zepyrulata* and *zevitellina).*

The present author agrees with Schilder's (1961) suggestion that *A.zevitellina* and *A.zepyrulata* are the same species represented by specimens in different developmental stages. Not fully developed species of Eratoinae often have an obsolete fossula, a feature which prompted Laws (1941) to associate his species with the European-Caribbean *Hespererato,* a group of species with an almost obsolete fossula but prominently denticulate lips.

Fig. 6. *Archierato zevitellina* (Laws) (= *zepyrulata* Laws). Pakaurangi Pt, L. Miocene; length 5.1mm. (from Laws, 1941, pl. 19, fig. 37).

Subfamily TRIVIINAE Troschel, 1863

Shell ovate or rounded, often inflated, sculptured with transverse dorsal ribs extending onto the base and into the aperture; the dorsal ribs either continuous or interrupted by a dorsal groove. Spire broad, slightly protruding or covered in adult specimens with the exception of *Semitrivia* Cossmann, aperture linear, lateral or central, sometimes wide, both lips denticulate; the columella generally extending deep into the aperture, but projecting in *Semitrivia.*

Genus **Ellatrivia** Iredale, 1931

Ellatriva Iredale, 1931, Rec. Austral. Mus. 18 (4) : 221. Type species by OD E. *merces* Iredale = *Triviella merces* Iredale, 1924. Recent, S.E. Australia.

Shell small, ovate or elongate-ovate, sculptured with transverse ribs, ribs continuous or interrupted by a broad and concave or narrow and shallow dorsal groove; extremities blunt, spire covered or slightly projecting, aperture moderately narrow or wide, lateral, somewhat curved, fossula moderately broad.

Generic differences between *Niveria* Jousseaume, 1884, *Cleotrivia* Iredale, 1930, *Fossatrivia* Iredale, 1931 and *Ellatrivia* Iredale are often nebulous, and some of the generic diagnostic characters are often of only specific or even ecophenotypic value. The differences in juvenile and adult specimens of the same species are often pronounced to such a degree as to warrant inclusion of specimens of a species in separate genera.

Schilder (1935) suggested that *Fossatrivia* Iredale be regarded as a subgenus of *Semitrivia* Cossmann, and *Ellatrivia* was accorded full generic rank by the same author. In his subsequent work on the Cypraeacea (1941), Schilder treated *Ellatrivia* as a subgenus of *Niveria* and *Fossatrivia* was given full generic rank.

The New Zealand fossil and Recent Triviinae are all assignable to *Ella-*

trivia. The Eocene species *E.pinguior* (Marwick) has a straighter aperture than is usual in *Ellatrivia*.

Ellatrivia pinguior (Marwick, 1926)

1926. *Trivia pinguior* Marwick, Trans. Proc. N.Z. Inst. 56 : 314, pl. 72, figs. 14,15.
1941. *?Fossatrivia pinguior* Marwick, Schilder, Arch. Moll. 73 : 72.
1966. *Trivia pinguior* Marwick, Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52, pl. 90.

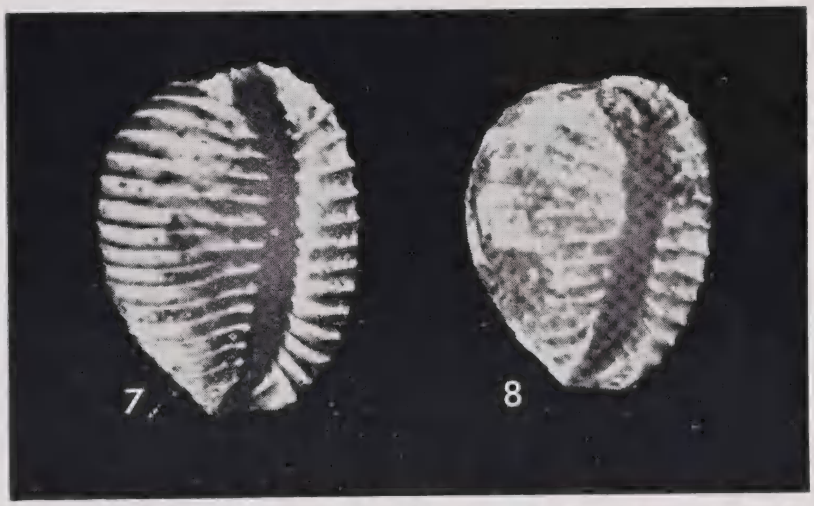
TYPE LOCALITY: Lorne, Oamaru, (Kaiatan), U.Eocene.

Ellatrivia kaiparaensis Laws, 1939 (Figs. 7,8)

1918. *Trivia avellanioides* (sic) McCoy, Marshall, Trans. Proc. N.Z. Inst. 50 : 273 (non *Cypraea (Trivia) avellanoides* McCoy, 1867).
1939. *Ellatrivia kaiparaensis* Laws, Trans. Proc. R. Soc. N.Z. 68 (4) : 489, pl. 64, figs. 26, 28,31.
1941. *Niveria (Ellatrivia) kaiparaensis* Laws, Schilder, Arch. Moll. 73 : 75.
1941. *Trivia aequiflora* Laws, Trans. Proc. R. Soc. N.Z. 71(2) : 144, pl. 19, figs. 44,49.
1966. *Ellatrivia kaiparaensis* Laws, Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.
1966. *Trivia aequiflora* Laws, Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.

TYPE LOCALITY: Pakaurangi Point, Kaipara, (Otaian), L.Miocene *(kaiparaensis* and *aequiflora)*.

Schilder (1961) considered *Trivia aequiflora* to be an immature specimen of *Ellatrivia kaiparaensis*. The more bulbous form, projecting spire, slightly wider aperture and not fully developed terminal ridge of the type specimen of *Trivia aequiflora* are characteristic features of immaturity in Triviinae. In this particular case, the changing developmental stage characters have been interpreted as generic characters, and one species was assigned to *Ellatrivia* and the other to *Trivia*.



Figs. 7, 8. 7. *Ellatrivia kaiparaensis* Laws. Pakaurangi Pt, L. Miocene; length 5.0mm. (from Laws, 1939, pl. 64, fig. 26). 8. *E. aequiflora* Laws) (= *kaiparaensis* Laws). Pakaurangi Pt., L. Miocene; length 3.7mm (from Laws, 1941, pl. 19, fig. 49).

Ellatrivia flora (Marwick, 1928)

1928. *Trivia flora* Marwick, Trans. Proc. N.Z. Inst. 58(4) : 482, figs. 118,119.
1941. *Niveria (Ellatrivia) flora* Marwick, Schilder, Arch. Moll. 73 : 75.
1966. *Trivia flora* Marwick, Fleming N.Z. Geol. Surv. Bull. No. 173 : 52, pl. 90, figs. 1071, 1072.

TYPE LOCALITY: Flower-pot Harbour, Pitt I., Chatham Islds., (Opoitian), L. Pliocene.

Ellatrivia zealandica (Kirk, 1882) (Fig. 9)

1882. *Trivia zealandica* Kirk, Trans. Proc. N.Z. Inst., 14 :409.
1893. *Trivia neozelanica* Kirk, Hutton, Macleay Mem. vol. Linn. Soc. N.S.W., p. 58 *(nom. null.).*
1915. *Trivia zealandica* Kirk, Suter, N.Z. Geol. Surv. Pal. Bull. 3 : 11, pl. 8, figs. 3a,b.
1966. *Ellatrivia zealandica* (Kirk), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.

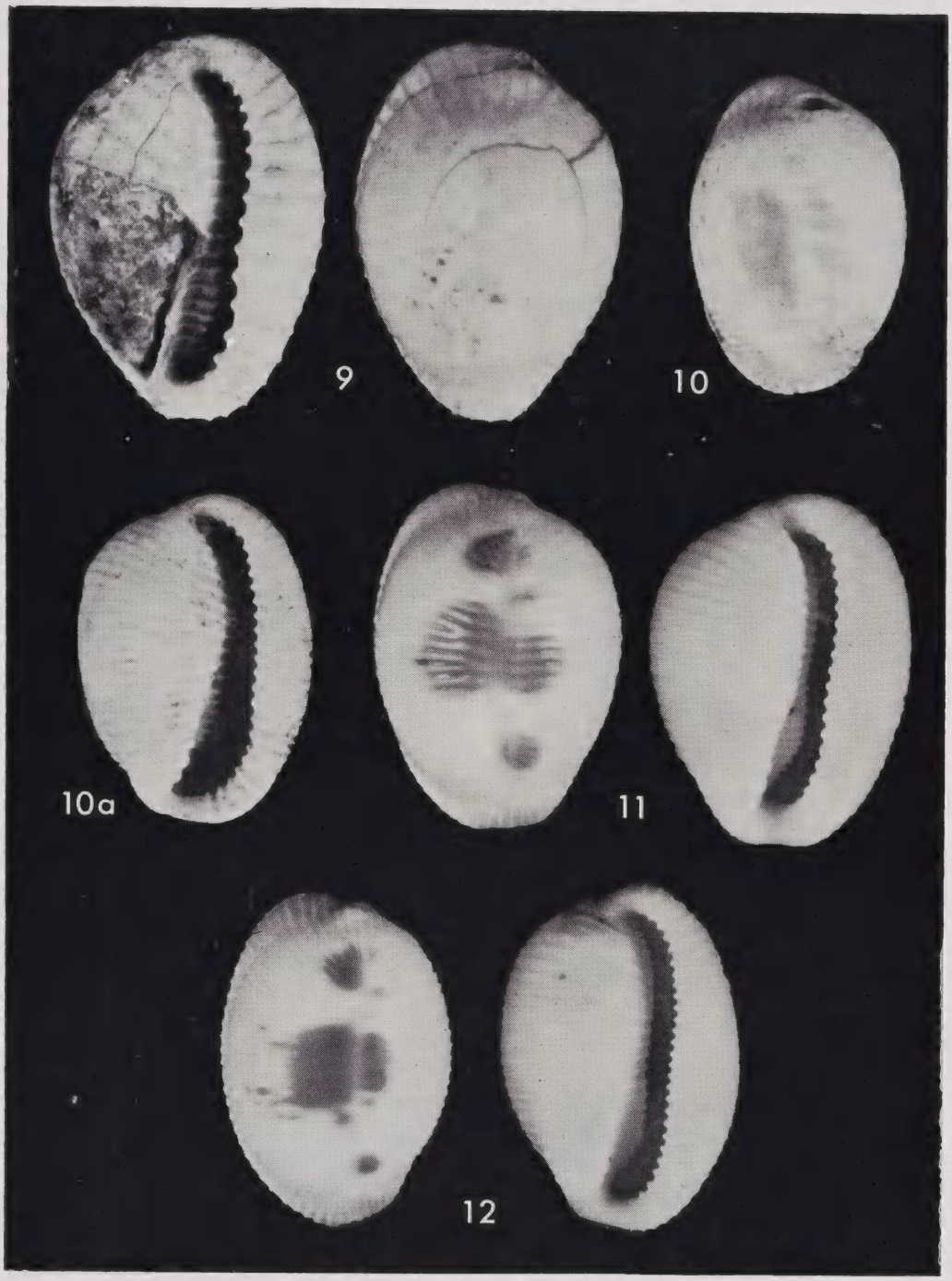
TYPE LOCALITY: Petane, Hawke's Bay, (Nukumaruan), L.Pleistocene.

In his original description, Kirk (1882) omitted to mention important diagnostic features of his new species, and no figure was appended. Suter (1915) announced the loss of Kirk's holotype of *E.zealandica,* and designated an incomplete and damaged specimen as the neotype of *Trivia zealandica.* Since two species of *Ellatrivia* occur in the Lower Pleistocene deposits at Petane, it is not certain which species Kirk originally diagnosed; the neotype of *Trivia zealandica,* however, appears to be a distinct species from *Ellatrivia merces* which also occurs at Petane. The specimen which is figured here, and which the present author believes is the *Trivia zealandica Kirk* as represented by the neotype, differs from *Ellatrivia merces* in the following features: it is more pyriform, the dorsum is more conoidal than flat, the aperture is very narrow and the labial teeth are fewer and more widely spaced; the carinated labial margin is weak and the interspaces of the dorsal ribs are wide and distinctly finely granulose near the margin. The figured specimen is 8.4 mm long, the width-ratio is 74% of length and the height-ratio 60% of length; there are 16 teeth on both lips.

Ellatrivia merces (Iredale, 1924) (Figs. 10-12)

1822. *Cypraea australis* Lamarck, Hist. Nat. anim. s. vert. 7 :404 (non Schröter, 1804).
1833. *Trivia australis* Lamarck, Quoy & Gaimard, Voy. Astrolabe 3 : 48, pl. 48, figs. 19-26 (non Schröter) 1804.
1846. *Cypraea australis* Lamarck, Reeve, Conch. Icon, pl. 24, fig. 138 (non Schröter, 1804).
1924. *Triviella merces* Iredale, Proc. Linn. Soc. N.S.W. 49(3) : 257, pl. 35, figs. 16,17.
1927. *Triviella memorata* Finlay, Trans. Proc. N.Z. Inst. 57 : 396, pl. 21, fig. 73 (March).
1927. *Triviella maoriensis* Mestayer, Proc. Malac. Soc. Lond. 17 : 186, figs. 3,4 (December).
1931. *Ellatrivia (merces) addenda* Iredale, Rec. Aust. Mus. 18(4) : 221 *(nom. nud.* — no description or figure).

TYPE LOCALITY: Port Jackson, N.S.W., Australia *(merces);* New Holland *(australis);* Ahipara Bay near Auckland, New Zealand *(memorata);* Reef Point, Ahipara Bay, New Zealand *(maoriensis).*



Figs. 9-12. 9. *Ellatrivia zealandica* (Kirk). Topotype from Petane, Hawke's Bay, L. Pleistocene; AIM-6105; length 8.4mm, width 6.3mm. 10, 10a. *E. merces* (Iredale). Petane, Hawke's Bay, L. Pleistocene; Powell coll.; length 11.9mm, width 8.1mm. 11. *E. merces* (Iredale). Takau Bay, New Zealand; Powell coll. No. 42751; length 13.0mm, width 9.5mm. 12. *E. merces* (Iredale). Shellharbour, N.S.W., Australia; Powell coll. No. 5329; length 12.8mm, width 8.8mm.

Finlay (1927) separated the New Zealand population of *Ellatrivia merces* from the Australian population of the species because shells from New Zealand were "shorter, higher, and more globose, with larger colour patches and less produced outer lip". Seventy-one Australian and 124 New Zealand specimens of *E.merces* were examined, and characteristics used by Finlay (loc. cit.) in differentiating his new species have been tabulated (Tables 1 and 2). It was found that the largest Australian specimen examined exceeded the largest New Zealand specimen by only 0.7 mm, and that neither population was more globose or had a higher dorsum than the other. The colour patches were found to be variable in both populations, and several New Zealand specimens had smaller colour blotches than Australian specimens. The width of the labial lip was found to be the same in both populations, and existing differences in the width of the labial lip were confined only to young and mature shells of both populations.

In the tables which follow (Tables 1,2), the width-ratio $= \frac{\text{Width}}{\text{length}}$ x 100 and the height-ratio $= \frac{\text{height}}{\text{length}}$ x 100; the number of teeth quoted is the actual number of teeth counted. The figured Pleistocene specimen of *E.merces* from Petane, has retained the rosy colour patches on the dorsum.

Table 1. Australian populations of *Ellatrivia merces* (Iredale).

No. of specimens	Length of shell (mm)	Width in % of length	Height in % of length	No. of labial teeth	No. of columellar teeth	Locality
46	9.0 - 14.3	64 - 75	52 - 61	20 - 27	16 - 23	Shellharbour, N.S.W.
4	9.9 - 14.0	67 - 71	51 - 56	21 - 28	18 - 22	Long Bay, N.S.W.
6	8.5 - 14.4	70 - 73	55 - 57	21 - 26	16 - 20	Victoria
8	14.3 - 15.7	66 - 69	54 - 58	23 - 28	19 - 22	Swansea, Tasmania
7	9.8 - 12.0	67 - 71	54 - 58	22 - 26	17 - 20	nr Fremantle, W.A.
71	**8.5 - 15.7**	**64 - 75**	**51 - 61**	**20 - 27**	**16 - 23**	**Range of 71 specimens**

Table 2. New Zealand populations of *Ellatrivia merces* (Iredale).

No. of specimens	Length of shell (mm)	Width in % of length	Height in % of length	No. of labial teeth	No. of columellar teeth	Locality
15	11.1 - 14.0	70 - 77	59 - 63	22 - 25	16 - 21	Ahipara (type locality)
70	9.0 - 14.3	66 - 75	55 - 62	20 - 26	16 - 21	Cape Maria van Diemen
2	9.3 - 11.5	69 - 70	56 - 57	23 - 26	17 - 20	Taranga, Hen Is.
1	13.4	68	56	23	22	Tairua
20	9.3 - 13.8	65 - 75	53 - 60	22 - 26	17 - 20	Takau Bay
3	7.9 - 15.0	69 - 73	59 - 60	21 - 24	16 - 19	Chatham Islands
5	9.0 - 13.0	69 - 72	57 - 61	20 - 24	15 - 21	Mt Maunganui
3	11.0 - 12.9	70 - 72	55 - 57	22 - 25	18 - 20	Whangaroa
3	10.6 - 12.8	68 - 72	58 - 60	24 - 26	18 - 22	Whangarei Heads
2	11.9 - 14.0	69 - 75	58 - 59	21 - 23	17 - 20	Petane, L. Pleistocene
124	**7.9 - 15.0**	**65 - 77**	**53 - 63**	**20 - 26**	**15 - 22**	**Range of 124 specimens**

Erroneous Record

Triviella gamma Mestayer, 1927

1927. *Triviella gamma* Mestayer, Proc. Malac. Soc. Lond. 17 :188, fig. 5.

TYPE LOCALITY: Bay of Islands, New Zealand (error!).

The species figured by Mestayer (1927) is obviously the Caribbean species *Niveria pediculus* (Linnaeus, 1758) and the paratype which has been examined is the same species. Finlay (1930) excluded this species from the New Zealand fauna, and remarked that Miss Mestayer received these shells from Suter, who in turn obtained them by exchange.

Family PEDICULARIIDAE H. & A. Adams, 1854

Genus **Pedicularia** Swainson, 1840

Pedicularia Swainson, 1840, Treat.Malac., pp.244, 357. Type species by M *P.sicula* Swainson, 1840. Recent, Mediterranean.

1844. *Thyreus* Philippi, Enum. Moll. Sic., 2 : 92. Type species by M. *T.paradoxus* Philippi, 1844 = *Pedicularia sicula* Swainson, 1840.

1925. *Pediculariella* Thiele in Kückenthal, Handb. Zool. 5 :88. Type species by OD *Pedicularia californica* Newcomb, 1865. Recent, W.coast America.

1935. *Pedicullariona* Iredale, Aust. Zool. 8 : 101. Type species by OD *Pedicularia stylasteris* Hedley, 1903 = ?*P.pacifica* Pease, 1865. Recent, Pacific.

Shell small, cap-shaped, unicoloured, with a flaring margin, dorsum striate, interstices minutely granulose; lips sharply edged, spire covered or projecting.

Pedicularia pacifica Pease, 1865

1865. *Pedicularia pacifica* Pease, Proc. Zool. Soc. Lond. p. 516.

1868. *Pedicularia pacifica* Pease, Amer. J. Conch. 4 : 96, pl. 11, figs. 17, 18.

1903. ?*Pedicularia stylasteris* Hedley, Mem. Aust. Mus. 4 : 342, figs. 69, 70.

1937. *Pedicularia maoria* Powell, Discovery Repts. 15 : 208, pl. 54, figs. 13. 14.

1944. *Pedicularia pacifica* Pease, Schilder, Ark. Zool. 36A : 29 (animal, radula, veligers).

1965. *Pedicularia pacifica* Pease, Kay, Bull. Brit. Mus. (Nat. Hist.) Zool. Suppl. 1 : 84, pl. 14, figs. 13, 14 (figd. lectotype).

TYPE LOCALITY: Apaian Isld. (= Abaiang I., Gilbert Islands) *(pacifica);* off Three Kings Islands, New Zealand, in 260 metres *(maoria).*

The New Zealand *P.maoria* is a typical *P.pacifica* Pease. The sculpture of alternating spiral threads and concentric striae and the excavated columella with the inner margin carinate are typical features of *P.pacifica.* In *P.pacifica* the spire is either visible or covered and in adult specimens the columella is edentulous. Young specimens are denticulate on the columella and in some mature specimens the radial ribs are visible in the centre of the columella.

Family CYPRAEIDAE Rafinesque, 1815

(= Porcellanidae Roberts, 1870)

Subfamily BERNAYINAE Schilder, 1927

(= Cypraeorbinae Schilder, 1927, = Zoilinae Iredale, 1935)

Genus **Bernaya** Jousseaume, 1884

Bernaya Jousseaume, 1884, Bull. Soc. Zool. France 9 :88. Type species by SD (Jousseaume, 1884) *Cypraea media* Deshayes, 1835. Eocene of Paris Basin, France.

Shell moderate in size, 20-50 mm in length, canals short, spire covered, sides rounded, base convex and concave anteriorly; labial lip broad, aperture moderately wide, labial teeth somewhat produced, fossula broad, smooth and concave, columella smooth and without a groove.

Bernaya zoiloides Schilder, 1958

1934. *Cypraea* sp. Ferrar, N.Z. Geol. Surv. Bull. No. 34 : 36 (Pahi Peninsula [*fide* Fleming, 1950].

1950. *Cypraea (?Bernaya)* n.sp. Fleming, Trans. Proc. R. Soc. N.Z. 78 : 249, fig. 1d.

1958. *Bernaya zoiloides* Schilder, Arch. Moll. 87 :179 *(nom. nov. pro Cypraea (?Bernaya)* sp. Fleming, 1950).

TYPE LOCALITY: Pahi greensands, North Auckland, (Bortonian), M.Eocene.

Bernaya chathamensis sp.n. (Fig. 13)

Shell moderate in size, 35.8 mm in length, rounded and broad, posterior extremity short, anterior extremity only slightly produced, spire short and covered. Sides rounded, labial margin dimpled, base convex but concave anteriorly, labial lip moderately broad and declivious anteriorly, aperture widening anteriorly but narrow and curved posteriorly, posterior canal deep. Labial teeth slightly produced, columellar teeth short, confined to the aperture and not extending on to the columella; terminal ridge merging, columella smooth and without a sulcus, fossula broad, concave, smooth and projecting. *Holotype measurements:* Length 35.8 mm; width 27.3 mm; height 21.1 mm; number of labial teeth 18, of columellar teeth 14.

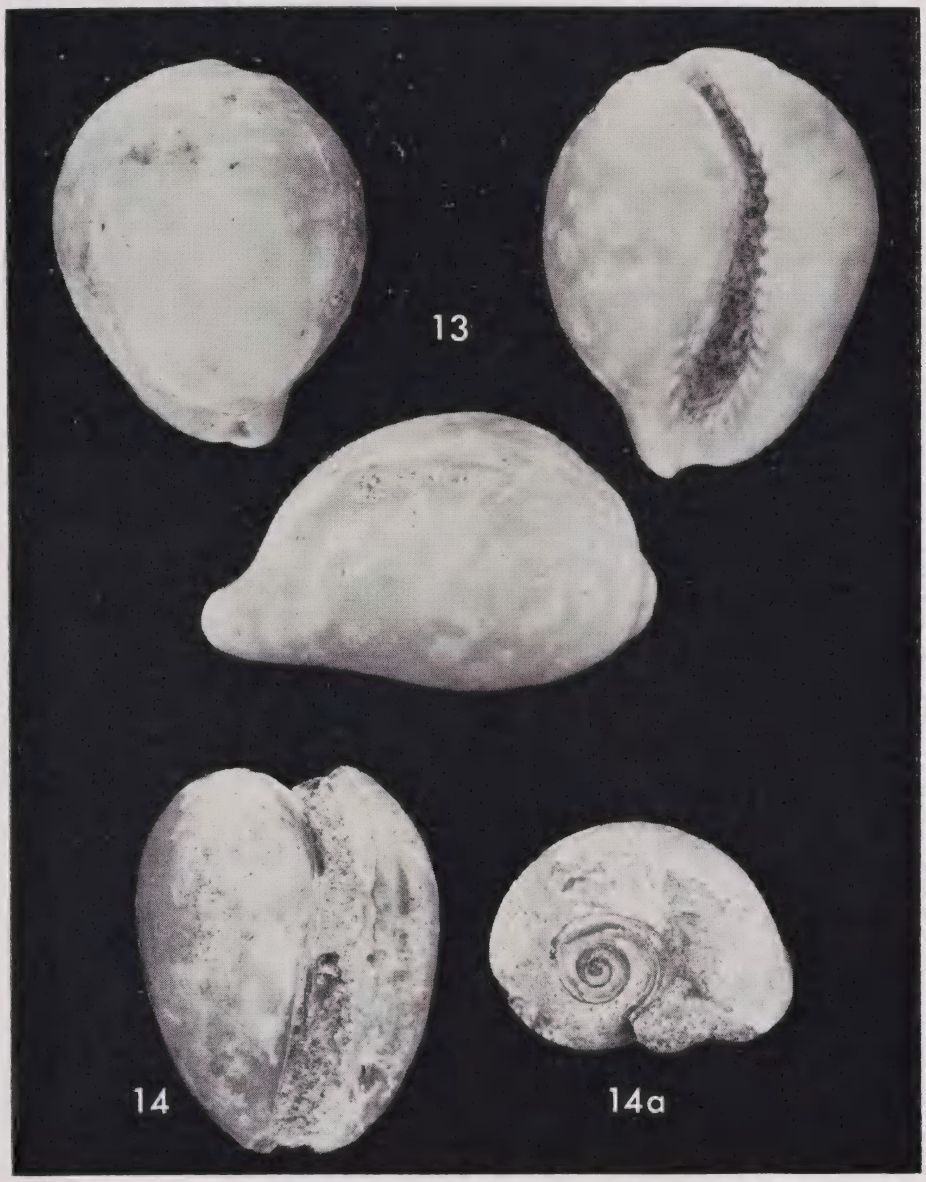
Location of holotype: Holotype No. TM-1325 in the Auckland Institute & Museum, Auckland, ex-A.Watherspoon.

TYPE LOCALITY: Flower-pot Harbour, Pitt Island, Chatham Islands, (Opoitian), L.Pliocene.

The new species bears no resemblance to any other New Zealand Cypraeidae nor to the larger species of the closely related *Zoila* Jousseaume, from Australian Tertiary deposits. Living *Zoila* species are confined to the South and West Australian region and one *Bernaya* species survives in West Australian waters. It appears that Bernaya became extinct in New Zealand in comparatively recent times.

Bernaya chathamensis was found to be associated in the Flower-pot Harbour deposits with *Olivella neozelanica* (Hutton), a species which does not appear to

have been recorded from older deposits than Waitotaran, Upper Pliocene. The other species occurring in the same deposits is the volutomitrid *Waimatea costulosa* (Marwick), which has previously been recorded from the Opoitan, Lower Pliocene deposits.



Figs. 13, 14. 13. *Bernaya chathamensis* sp. n. Flower-pot Harbour, Pitt I., Chatham Islands; holotype AIM No. TM-1325; length 35.8mm, width 27.3mm. 14. *B. ficoides* (Hutton). Kakanui Tuffs, North Otago, L. Oligocene; AIM No. 8995; length 33.1mm. 14a. Spire view of specimen 30.5mm in length from the same locality.

Bernaya ficoides (Hutton, 1873) (Figs. 14-15)

1873. *Volvaria ficoides* Hutton, Cat. Tert. Moll. Echin. N.Z., p. 8.

1915. *Cypraea ficoides* (Hutton), Suter, N.Z. Geol. Surv. Pal. Bull. No. 3 : 11, pl. 1, fig. 2 (28 x 21 mm).

1941. *Notoluponia ficoides* (Hutton), Schilder, Arch. Moll. 73 : 95.

1966. *Cypraea ?ficoides* (Hutton), Fleming, N.Z. Geol. Surv. Bull. No. 173 :52.

TYPE LOCALITY: Oamaru, Tertiary of New Zealand.

Shell moderate in size, 25-52mm, broad and high, width 71%-81% of length (75% in type specimen), rounded, extremities short; the spire prominent but not projecting, 12.0 mm wide, consisting of 3-3½ turns. Sides rounded, labial lip keeled and base distinctly convex. Aperture narrow, curved anteriorly, labial teeth number 25-27, and columellar teeth 24.

Three specimens from the Kakanui Tuffs, N. Otago, (L.Oligocene) were laterally compressed through fossilization. The dimensions of these three specimens are

Fig. 15. *Bernaya ficoides* (Hutton). Ngahararu Point, Parengarenga Harbour, L. Miocene. Geol. Dept. Univ. Auckl.; length 49.5mm.

as follows: length, 33.0 mm, width 25.0 mm; length 30.3 mm, width 23.7 mm; length 25.4 mm, width 18.0 mm.

A specimen from muddy sandstone beds at Ngahararu Point, Parengarenga Harbour (L.Miocene), was in almost perfect condition; the length of this particular specimen was 49.5 mm, the width 40.0 mm and the height 34.2 mm, with 27 labial teeth and 24 columellar teeth. An internal cast of another specimen *c.* 52.0 mm in length, showed 25 labial and 24 columellar teeth.

The specimen from Parengarenga Harbour bears a close resemblance to a specimen of *Bernaya obesa* Deshayes, from Persia, as figured by Schilder (1941, pl.8, fig.8); in this particular specimen the spire is also exposed, 11.0 mm wide, and the labial lip is longitudinally keeled.

Subfamily CYPRAEINAE Rafinesque, 1815

(= Talpariini Schilder, 1936, = Mauritiinae Steadman & Cotton, 1946)

Genus, **Lyncina** Troschel, 1863

Lyncina Troschel, 1863, Geb. Schnecken 1 :208. Type species by SD (Tryon, 1883) *Cypraea lynx* Linnaeus, 1758. Recent, Indo-Pacific.

Shell moderate in size, ovate to cylindrical, rarely pyriform, sides margined or rounded, base flat or convex; aperture straight and narrow, teeth numerous and close-set, lighter than interstices, columellar groove distinct.

Lyncina vitellus (Linnaeus, 1758)

1758. *Cypraea vitellus* Linnaeus, Syst. Nat. ed. 10, pl. 721.

1931. *Mystaponda orcina* Iredale, Rec. Aust. Mus. 18(4) : 220, pl. 24, figs. 9,10 (N.S.W.).

1938. *Cypraea (Lyncina) vitellus polynesiae* Schilder & Schilder, Proc. Malac. Soc. Lond. 23(4) : 187.

1967. *Lyncina vitellus* (Linnaeus), Powell, Rec. Auckland Inst. Mus. 6 (3) 185, pl. 36, figs. 1-3.

TYPE LOCALITY: Sunda Islands, Indonesia.

The species is known only from the Poor Knights Islands, where several specimens have been taken by divers at a depth of 60 - 100 feet (20 - 33 m). Names bestowed on Indian Ocean populations and ecophenotypic variants of the species, have been omitted from the synonymy.

Subfamily PUSTULARIINAE Gill, 1871

(= Erosariinae Schilder, 1924, = Nariinae Schilder, 1932)

Genus **Erosaria** Troschel, 1863

Erosaria Troschel, 1863, Geb. Schnecken, 1 : 210. Type species by SD (Jousseaume, 1884 *Cypraea erosa* Linnaeus, 1758. Recent, Indo-Pacific.

Shell moderate in size, ovate to pyriformly-ovate, sides margined and pitted, spire short, aperture narrow, dilated anteriorly; teeth strong, coarse and produced on labial lip but confined to the aperture or the columella, canals narrow and deep. Fossula moderately narrow, columella smooth and without a groove.

Erosaria cernica tomlini Schilder, 1930

1930. *Erosaria cernica tomlini* Schilder, Proc. Malac. Soc. Lond. 19 :51.

1965. *Erosaria cernica tomlini* Schilder, Powell, Rec. Auckland Inst. Mus. 6(2) : 164, pl. 23, figs. 15-19.

TYPE LOCALITY: Lifu, Loyalty Islands.

Records are from Poor Knights Islands, 60-120 ft (20-30 m), and Cape Maria van Diemen, in beach debris.

Specimens from the Poor Knights Islands range of 27-31 mm in length and have a width-ratio of 64% - 68% of length; the width ratio coincides in morphometric characters with the Indian Ocean. *E.cernica* s.str. (Schilder, 1930, gives the length of *E.cernica cernica* as 17-27 mm with a width-ratio of 61% - 75% and for *E.cernica tomlini* the length is given as 12-23 mm with a width ratio of 59% - 66%). The small and slender specimen from Cape Maria van Diemen has a width-ratio of 61% and agrees with the Pacific *E.cernica tomlini*. In some Poor Knights Islands specimens the dorsal spots are regular and the lateral spots sparse and nebulous, characters given by Schilder (loc. cit.) for the Indian Ocean *E.cernica*. Features of colour and width in relation to length in Cypraeidae are evidently influenced by ecological factors rather than geographic subspeciation, and of doubtful value in discriminating the Indian and Pacific Ocean populations of *E.cernica*.

To Powell's synonymic list (1965) should be added *Erosaria percomis* Iredale, 1931 (Sydney Harbour), *E.ogasawarensis* Schilder, 1944 (Bonin Islands), *E.tomlini maturata* Kira, 1959 (Ryukyu Islands) and *Cypraea cernica marielae* C. Cate, 1960 (Hawaiian Islands).

Subfamily ERRONEINAE Schilder, 1927

(= Cypraeovulidae Schilder, 1927)

Genus **Notoluponia** Schilder, 1935

Subgenus **Notadusta** Schilder, 1935

Notadusta Schilder, 1935, Proc. Malac. Soc. Lond. 21 (6) : 350. Type species by OD *N.victoriana* Schilder, 1935. Miocene of Victoria, Australia.

Species of *Notadusta* differ from *Notoluponia* in features of a declivious labial lip in the anterior region, the prominent posterior canal and the smooth columella which is not crossed by the columellar teeth.

Notoluponia (Notadusta) trelissickensis (Suter, 1917) (Fig. 16)

1917. *Cypraea (Luponia) trelissickensis* Suter, N.Z. Geol. Surv. Pal. Bull. No. 5 : 12, pl. 11, fig. 11.

1941. *Notadusta trelissickensis* Suter, Schilder, Arch. Moll. 73 :98.

1966. *Cypraea (Luponia)*? *trelissickensis* (Suter), Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.

TYPE LOCALITY: Whitewater Creek, Trelissick Basin, Canterbury, (Duntroonian), U.Oligocene.

There are 2 specimens of *N.trelissickensis* in the Finlay collection: one specimen *c.* 19.4 mm in length, with part of the anterior extremity missing, from the Kakanui Tuffs, N. Otago (Whaingaroan), Lower Oligocene, and a well preserved specimen from Pakaurangi Point, Kaipara, (Otaian), Lower Miocene. The Pakaurangi specimen measures 24.3 mm in length, 14.5 mm in width, labial teeth number 22 and columellar teeth 17; the first 5 anterior labial teeth are produced to the margin. The dorsum is humped, the labial side prominently margined and bent up, the labial lip is recurved towards the umbilicus which is covered; the columellar side is rounded and not margined and distinctly constricted anteriorly. The columellar teeth are confined to the aperture and do not extend over the columella as in *Notoluponia,* and both the fossula and columella are completely smooth; there is a single terminal ridge.

Fig. 16. *Notoluponia (Notadusta) trelissickensis* (Suter). Pakaurangi Pt, L. Miocene; AIM No. 8992; length 24.3mm, width 14.5mm.

The species extends from the Lower Oligocene to the Lower Miocene, and no distinguishing characters could be perceived in specimens from the older and younger deposits.

Notoluponia (Notadusta) clifdenensis sp.n. (Figs. 17-18)

Shell moderate in size, 30-37 mm in length, elongate-ovate, sub-cylindrical, dorsum smooth; the labial lip margined, particularly at the extremities, and the columellar lip margined from the centre towards the anterior extremity. Aperture narrow, slightly recurved posteriorly, labial lip declivious anteriorly; the first five anterior teeth slightly produced but not reaching the margin, remainder of teeth short, columellar teeth small and confined to the aperture without extending over the columella. Posterior canal deep and well defined, columella smooth, fossula moderately broad, steep, smooth and not projecting; a single terminal ridge borders the anterior outlet, spire distinct and slightly projecting.

Holotype measurements: Length 37.0 mm; width 21.7 mm; height 19.0 mm; number of labial teeth 25; of columellar teeth 18.

Paratype measurements: Length 30.8 mm; width 18.0 mm; height 15.4 mm; number of labial teeth 25; of columellar teeth 15 + (lip incomplete).

TYPE LOCALITY: Clifden, band 6B, Southland, (Altonian), Mid-Miocene.

Location of types: Holotype No. TM-1324 and paratype No. TM-1324/1 in the Auckland Institute & Museum, Auckland, ex-Finlay collection.

N.clifdenensis differs from *N.trelissickensis* in being larger, more solid and not pyriform and having marginal pads at both sides of the anterior extremity instead being constricted; the labial lip is broader in *N.clifdenensis*, the labial teeth do not reach the margin anteriorly and the aperture is straighter and less curved posteriorly. The maximum height in *N.clifdenensis* is more towards the centre of the dorsum and not in the posterior third as in *N.trelissickensis* which is distinctly humped; the dorsum descends more steeply towards the anterior extremity in *N.trelissickensis* than in *N.clifdenensis*, and the spire is covered in the former but visible and projecting in the latter.

Notoluponia clifdenensis is closely related to *N.victoriana* (Schilder,1935) from Muddy Creek, Victoria, Australia, but is twice as large, the fossula is steeper and completely smooth and not transversely ribbed or denticulate on the inner margin and the teeth are also shorter.

The two type specimens have been marked *"clifdenensis"* in a MS. note on the label, and Finlay's proposed but not published name has been retained for the new species.

?Notadusta n.sp. figured by Beu (1970, pl.4, fig.29) from Naakonui Stream, Wairapa, (Tongaporutuan), Upper Miocene, appears to be the same species as *N.clifdenensis*.

Figs. 17, 18. 17. *Notoluponia (Notadusta) clifdenensis* sp. n. Clifden, band 6B, Southland, M. Miocene; holotype AIM No. TM-1324 (old No. 8996); length 37.0mm, width 21.7mm. 18. Paratype from same locality, AIM No. TM-1324/1 (old No. 8996); length 30.8mm, width 18.0mm.

Family OVULIDAE Fleming, 1828

(= Amphiperasidae H. & A. Adams, 1854)

Subfamily EOCYPRAEINAE Schilder, 1924

(= Jenneriinae Thiele, 1929, = Sulcocypraeinae Schilder, 1932)

Shell moderately small, pyriform to ovate, spire involute, aperture narrow and curved posteriorly, denticulate on both lips, labial teeth not reaching the posterior canal. Fossula smooth, columella smooth or spirally striate and without a sulcus. Dorsum finely spirally but sometimes obsoletely striate, sides finely granulose.

Genus **Eocypraea** Cossmann, 1903

Eocypraea Cossmann, 1903, Ess. paléoc. comp. 5 :162. Type species by OD *Cypraea inflata* Lamarck, 1802. Eocene of France.

Shell small, 20-30 mm in length, pyriform and inflated, anterior extremity produced, posterior extremity produced and curved, spire involute. Labial side weakly margined, columellar side rounded, anterior of labial lip declivious, aperture widening anteriorly; teeth small but developed on both lips, labial teeth not reaching posterior canal. Columella spirally striate and without a suclus, fossula shallow, moderately broad and smooth. Dorsum finely and densely spirally striate, sides and base macroscopically granulose.

Eocypraea novaezealandiae (Schilder, 1941)

1921. *Cypraea* sp. Marshall & Murdoch, Trans. Proc. N.Z. Inst. 53 : 81, pl. 18, fig. 6.

1941. *Notoluponia novaezealandiae* Schilder, Arch. Moll. 73 :95 *(nom. nov. pro Cypraea* sp. Marshall & Murdoch, 1921).

1950. *Cypraea (?Eocypraea) murdochi* Fleming, Trans. Proc. R. Soc. N.Z. 78 : 248, textfigs. 1a-c.

1966. *Cypraea (Eocypraea) ?murdochi* Fleming, N.Z. Geol. Surv. Bull. No. 173 : 52.

TYPE LOCALITY: Pahi greensands, North Auckland, (Bortonian), Mid-Eocene.

Cypraea murdochi Fleming is an objective synonym of *E.novaezealandiae* (Schilder), as both taxa were based on the same type specimen. *Eocypraea* actually belongs to the Ovulidae and not the Cypraediae, but due to the bad preservation of the solitary type of *E.novaezealandiae* a location in *Eocypraea* is only tentative.

Subfamily OVULINAE Fleming, 1828

Shell small to moderate in size, pyriform to fusiform, dorsum frequently with a carina, extremities produced or beaked, spire involute; labial lip margined, columellar side rounded, aperture wide or narrow, teeth obsolete or absent. Fossula smooth, columella rounded, dorsum finely spirally striate, sides macroscopically granulose; generally unicoloured, occasionally with a single dorsal band.

Genus **Volva** Röding, 1798

Volva Röding, 1798, Mus. Bolten., p. 21. Type species by T *Bulla volva* Linnaeus, 1758. Recent Indo-Pacific.

1810. *Radius Montfort*, Conch. Syst. 2 : 626. Type species by OD *Bulla volva* Linnaeus, 1758.

1840. *Birostra* Swainson, Treat. Malac., p.325. Type species by M *Bulla volva* Linnaeus, 1758.

Subgenus **Phenacovolva** Iredale, 1930

Phenacovolva Iredale, 1930, Mem. Queensl. Mus. 10 : 85. Type species by OD *P.nectarea Iredale*, 1930 = *Bulla birostris* Linnaeus, 1767. Recent, Indo-Pacific.

1817. *Radius* Schumacher, Ess. nouv. syst., p. 259. Type species by M *R.brevirostris* Schumacher, 1817 = *Bulla birostris* Linnaeus, 1767 (non *Radius* Montfort, 1817).

Shell slender and fusiform, extremities produced into short or long and slender canals, aperture narrow or wide, dilated anteriorly, labial teeth obsolete or absent, columella smooth, fossula narrow or absent.

Species of *Phenacovolva* have a less ventricose body whorl in comparison to *Volva* s.str., and the dorsal spiral sculpture is often visible only at the extremities.

Volva (Phenacovolva) longirostrata (Sowerby, 1828)

— *Volva birostris* auctt. (non Linnaeus, 1767).

1828. *Ovulum longirostratum* Sowerby, Zool. Journ. 4 :160.

1830. *Ovulum longirostratum* Sowerby, Spec. Conch. Mon. *Ovulum* 1(1) : pl. 2, figs. 46-48.

1848. *Ovulum recurvum* Adams & Reeve, Voy. Samarang, pl. 21, pl. 6, figs. 3a-c.

1855. *Ovulum longirostratum* Sowerby, Thes. Conchyl. 2 :481, pl. 100, figs. 59,60.

1865. *Ovulum longirostratum* Sowerby, Reeve. Conch. Icon. 15 :pl. 3, figs. 40a-c.

1932. *Volva birostris* Linnaeus, Schilder, Proc. Malac. Soc. Lond. 20(1) : 56,62, pl. 5, fig. 78 (non *Bulla birostris* Linnaeus, 1767).

1966. *Phenacovolva birostris* (Linné), Habe & Kosuge, Shells world col. 2 :37, pl. 13, fig. 1 (non *Bulla birostris* Linnaeus, 1767).

1966. *Volva longirostrata* (Sowerby), Schilder, Veliger 9(2) : 98-99.

TYPE LOCALITY: None.

Schilder (1966) in his report on the Linnaen types of Cypraeidae, remarked on the presence of 2 different species in the Linnaean collection, i.e. *Volva brevirostris* (Schumacher,1817) and *V.longirostrata* (Sowerby,1882). That author pointed out that only the specimen of *V.brevirostris* corresponded to Linnaeus' description; this specimen was considered to be the holotype of *V.birostris* (Linnaeus). Authors following Schilder's findings will have to substitute *V.birostris* (Linnaeus) for *V.brevirostris* (Schumacher) and *V.longirostrata* (Sowerby) for *V.birostris* auctt. Authors disagreeing with Schilder's type selection should consider the Linnaean *Bulla birostris* to be a *nomen dubium* in view of the presence of two different species in the type collection; in this particular case *Volva longirostrata* (Sowerby) would still remain the taxon applicable to the species recorded from New Zealand.

Volva recurva (Adams & Reeve) from the China Seas appears to belong to *V.longirostrata* and no *V.birostris*. The species is very slender (width 23% of length) the canals are produced, slender and recurved, the shell is white and tinged with buff and no denticles are visible on the labial lip, and the funiculum is absent.

Several specimens of *V.longirostrata* were taken by divers at the Poor Knights Islands on primnoidean gorgonians at 150 ft (46 m) depth. In New Zealand specimens the spiral striae are visible along the whole length of the dorsum, and one specimen was streaked with orange on the columella. For further details see Powell (1971, this volume).

Genus **Simnia** Risso, 1826

Simnia Risso, 1826, Hist. nat. L'Eur. Merid. 4:235. Type species by SD (Gray, 1847) *S.nicaeensis* Risso,1826. Recent, Mediterranean.

1884. *Neosimnia* Fischer, Man. Conchyl., p. 664. Type species by M *O.spelta* Linne = *Bulla spelta* Linnaeus, 1758. Recent, Mediterranean.

Shell small, 10-30 mm, slender and elongate, extremities shorter than in *Volva* Röding; dorsum with or without a dorsal carina. Aperture narrow, widening anteriorly, labial lip narrow, flat or convex, reflected or inflected, teeth obsolete or absent, columella rounded, edentulous, and occasionally longitudinally keeled; fossula narrow or obsolete, funiculum obsolete.

Simnia sp. (Fig. 19)

One specimen 11.0 mm in length and 3.6 mm in width, from Altonian deposits (L.Miocene) of Kaipara Harbour, has been examined. The aperture is narrow but dilated anteriorly, the labial lip is narrow, flat, edentulous and inflected; part of the extremities are missing. The dorsum has an obsolete but distinguishable dorsal transverse carina in the posterior quarter; the columella is smooth and longitudinally keeled, and the fossula is narrow and smooth.

The small size, short extremities, dorsal carina and narrow fossula, indicate a placement of the new species in *Simnia* rather than the volvine subgenus *Phenacovolva* Iredale. The new species will be described in detail by Mr. J. A. Grant-Mackie, in a future evaluation of the Altonian fauna of Kaipara Harbour.

Fig. 19. *Simnia* sp. Kaipara Harbour, L. Miocene. Geol. Dept. Univ. Auckl.; length 11.0mm.

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NEW MOLLUSCAN SPECIES OF STROMBUS (STROMBIDAE) AND CANCILLA (MITRIDAE) FROM NEW BRITAIN AND TAIWAN

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Abstract. A species of *Strombus* of the subgenus *Dolomena* from New Britain and a species of *Cancilla* of the subgenus *Ziba* from Taiwan are described as new to science.

Family STROMBIDAE Rafinesque, 1815

Genus **Strombus** Linnaeus, 1758

Strombus Linnaeus, 1758, Syst. Nat., ed. 10, p. 742. Type species by SD (Montfort, 1810) *Strombus pugilis* Linnaeus, 1758. Recent, Caribbean.

Subgenus **Dolomena** Iredale, 1931

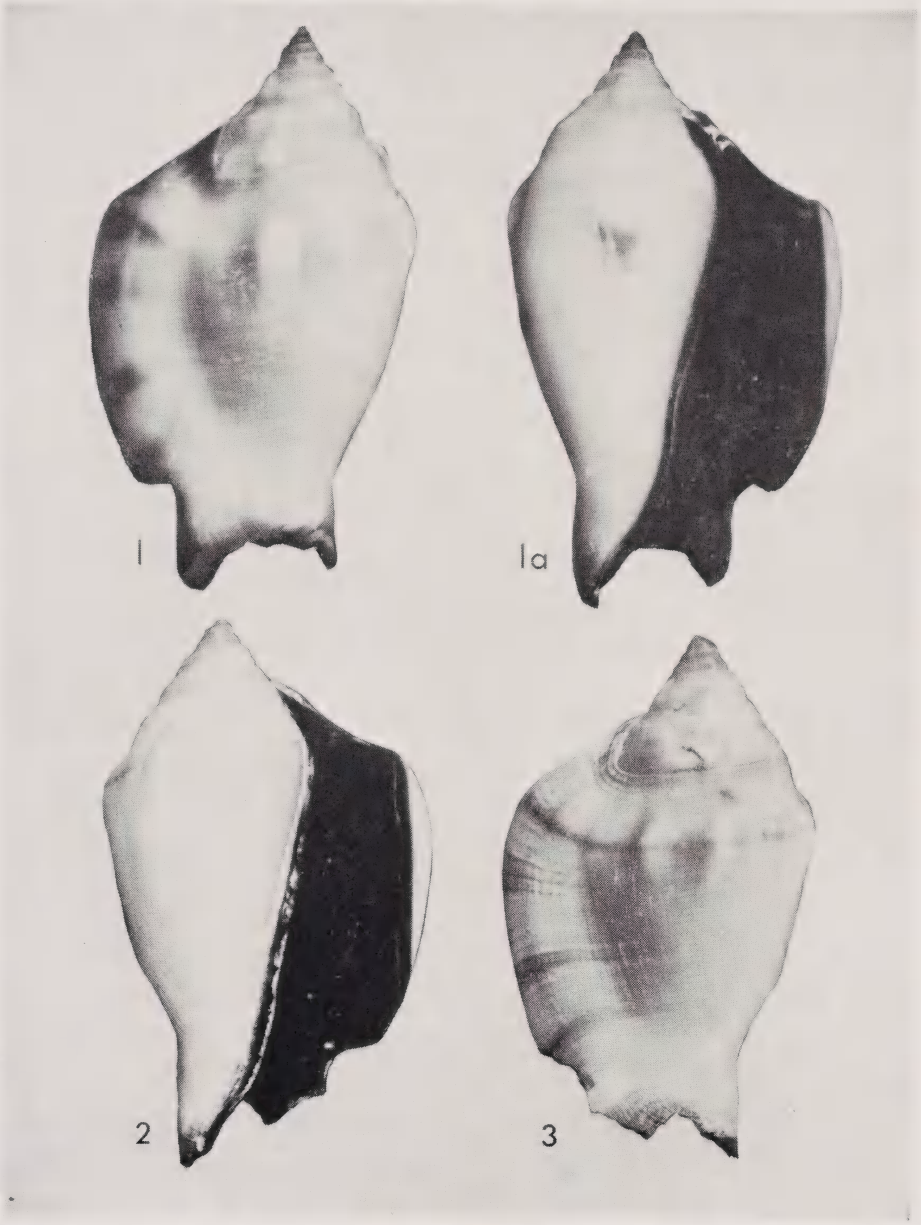
Dolomena Iredale, 1931, Rec. Aust. Mus. 18 (4) : 212, 232. Type species by OD *Strombus pulchelus Reeve* = *Strombus plicatus pulchellus* Reeve, 1851. Recent, Indo-Pacific.

Strombus (Dolomena) kleckhamae sp.n. (Figs. 1-3)

Shell moderate in size, 39 - 50 mm in length, solid and moderately heavy; spire short and slightly elevated, whorls 9 inclusive of 3 smooth and glassy nuclear whorls, whorls concave below suture. Sculptured with 13 swollen and broad varices, fine and elevated axial riblets numbering 40 -45 on antepenultimate whorl and becoming obsolete on the last 2 whorls; fine spiral threads encircling whorls, 5 - 10 on penultimate whorl and 40 - 45 on body whorl; spiral threads visible only on last half of body whorl toward labial lip. Dorsal side of body whorl and occasionally penultimate whorl with 5-6 small but distinct knobs. Aperture long and flaring, commencing at antepenultimate whorl; labial lip thickened and inflected, stromboid notch and siphonal notch both prominent. Interior labial lip sculptured with 8-34 lirae, some of them bifurcate, extending almost to edge of labial lip; columella calloused and glazed, swollen anteriorly, and sculptured with 10-16 lirae on parietal wall, lower half of the columella smooth. Siphonal canal produced and recurved towards dorsum. Colour of shell cream, leaden-grey or fawn, with irregular brown stains on early whorls, a brown spiral line passing through the knobs on body whorl and 5 broad, short brown stripes on edge of labial lip; aperture, columella and tip of siphonal canal dark purple-brown.

TYPE LOCALITY: West side of Matupi Island, Simpson Harbour, Rabaul, New Britain, Territory of Papua and New Guinea; in pumice bank, 10 feet (3 metres) above sea-level.

Rec. Auckland Inst. Mus. 8: 131-135 December 17th 1971



Figs. 1-3. *Strombus (Dolomena) kleckhamae* sp. n. 1-1a. Matupi I., Simpson Harbour, Rabaul, New Britain. Holotype AIM No. TM-1326; length 49.8mm. 2. Paratype No. 1 from type-locality; length 39.7mm. 3. Paratype No. 2 from Rabaul, New Britain; length 41.8mm.

Holotype: Auckland Institute and Museum No. TM-1326; length 49.8 mm, width 30.0 mm, height of aperture 41.0 mm (leg. W. M. English,1967); 8 obscure lirae on labial wall and 10 lirae on parietal wall (Fig. 1-1a).

Paratypes: No. 1. Specimen from the type locality, length 39.7 mm, width 25.9 mm, height of aperture 32.2 mm; 29 distinct lirae on labial wall and 16 lirae on parietal wall (coll. W. M. English) (Fig. 2). No. 2. Specimen from Rabaul, New Britain, obtained by Mrs. A. Kuster, length 41.8 mm, width 25.0 mm, height of aperture 33.3 mm; 34 distinct lirae on labial wall and 16 lirae on parietal wall (author's coll.) (Fig. 3).

Strombus (Dolomena) kleckhamae bears no real resemblance to any living species but is superficially similar to *Strombus rutteni* Altena, 1942, from the Indonesian Pliocene. *Strombus rutteni* has a higher spire, sutural cords, angulate whorls which are prominently ribbed and a very broad body whorl; the columella is not swollen anteriorly and is finely denticulate, and the siphonal canal is short and straight.

The pumice bank deposit at Matupi Island contains strata of "semifossil" molluscs, which were presumably deposited there in the course of the recent volcanic uplift during the eruption of Matupi volcano in 1937. The well preserved colour of the 3 specimens suggests that *Strombus (Dolomena) kleckhamae* still lives in Simpson Harbour.

The new species is named for Mrs. Marjorie Kleckham, Port Moresby, Papua, who first brought this species to my attention.

Family MITRIDAE Swainson, 1831

Subfamily IMBRICARIINAE Troschel, 1867

Genus **Cancilla** Swainson, 1840

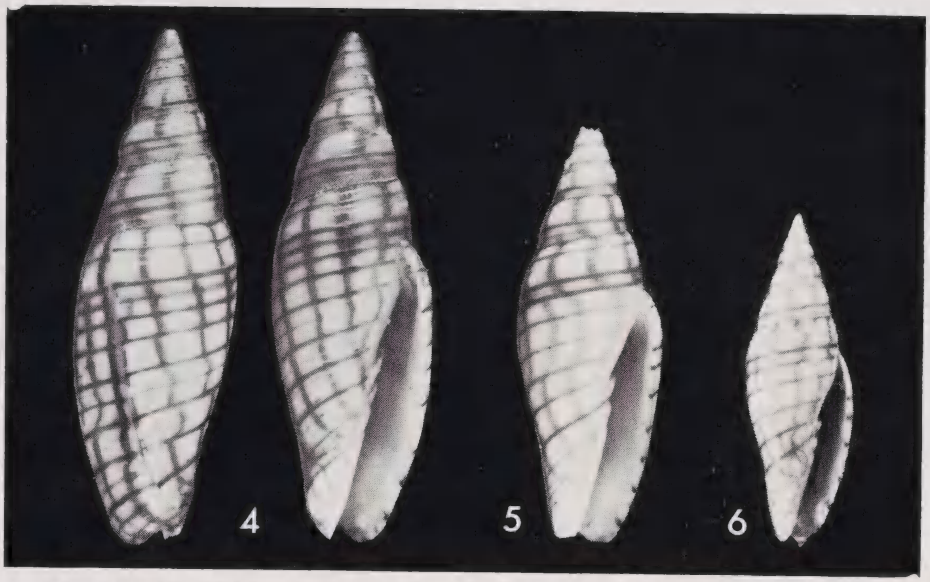
Cancilla Swainson, 1840, Treat. Malac., pp. 130, 320. Type species by SD (Herrmannsen, 1846. *Tiara isabella* Swainson, 1831. Recent, Sino-Japanese region.

Subgenus **Ziba** H. & A. Adams, 1853

Ziba H. & A. Adams, 1853, Gen. Rec. Moll. 1 : 179. Type species by SD (Wenz, 1943) *Mitra (Ziba) carinata* Swainson = *Mitra carinata* Swainson, 1824. Recent, West Africa.

Cancilla (Ziba) cloveri sp.n. (Figs. 4-8)

Shell moderately small, 17-27mm, fusiformly-elongate, moderately solid and shining. Pinkish-white in colour, ornamented with 1-3 reddish-brown spiral lines on penultimate whorl and 7-12 lines on body whorl; additional narrow, wavy and occasionally chevron-shaped axial lines bisecting the spirals. Teleoconch of 7-8 convex whorls, protoconch missing in adult specimens, but consisting of 3 smooth, glassy nuclear whorls in the juvenile paratype. Early whorls sculptured with 3-5 flattish spiral cords and small pits in intersticial grooves; spiral cords and intersticial pits becoming less prominent on ultimate 3 whorls. Penultimate whorl with 5-6 obsoletely pitted spiral grooves, intervening spiral cords only slightly elevated or completely flat. Body whorl



Figs. 4-6. *Cancilla (Ziba) cloveri* sp. n. *c.* 75 miles S.W. of Kaushiung, Formosa Strait, Taiwan, 70 fathoms (128 metres). 4. Holotype AIM No. TM-1335; length 26.3mm. 5. Paratype No. 1; length 21.7mm. 6. Paratype No. 2; length 17.0mm (spec. juv.)

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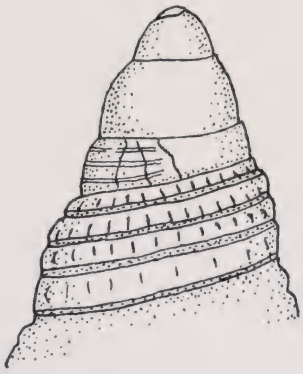

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Figs. 7, 8. *Cancilla (Ziba) cloveri* sp. n. 7. Half-row of radula extracted from holotype. 8. Protoconch of immature paratype No. 2.

with 14-17 spiral grooves, grooves generally prominent only near suture and almost obsolete on remainder of body whorl and visible as finely incised smooth lines. Aperture narrow and fusiform, longer than spire, smooth within; edge of liabial lip smooth, columella glazed but not calloused, 5-6 columellar folds decreasing in size anteriorly. Siphonal notch distinct, siphonal canal straight.

The radula of the holotype (Fig. 7) measured 4.4mm in length and 1.24mm in width, and contained 68 rows (+ 2 nascentes) of teeth; teeth were broken and very worn in the first 20 anterior rows. The rachidians are equipped with 10 large cusps which decrease laterally in size and the laterals have 16 teeth.

TYPE LOCALITY: Approximately 75 miles (120 km) southwest of Kaushiung, Formosa Strait, Taiwan, in 70 fathoms (128m).

Holotype: Auckland Institute and Museum No. TM-1335; length 26.3mm, width 8.5mm, height of aperture 15.6mm (Fig. 4).

Paratypes: No. 1. Length 21.7mm, width 7.6mm, height of aperture 13.7mm in coll. P.Clover (Fig. 5). No. 2 Length 17.0mm, width 5.5mm, height of aperture 10.0mm in author's coll. (Fig. 6).

Cancilla (*Ziba*) *cloveri* is similar to *C.rehderi* (Webb, 1958), from 100fm (193m) off Tosa, Japan; the latter species is larger, more fusiform and slender, the whorls are almost flat and not convex, the aperture equals in height the spire, and the spiral grooves are prominently punctate over the entire body whorl. In *C.rehderi* the spiral cords are covered with reddish-brown spots and there is no trace of longitudinal line ornamentation; in *C.cloveri* the spiral and longitudinal lines are arranged at random and do not follow either the spiral cords or grooves. In *C.cloveri*, the last two-thirds or one-half of the body whorl is smooth apart from widely spaced, finely incised spirals, whereas in *C.rehderi* the spirals are deep and pitted and the cords elevated.

The species has been named for Mr. Philip Clover, Rota Cadiz, Spain, who kindly drew my attention to the new species.

Acknowledgements. I would like to record my thanks to Mr. W. M. English, Konedobu, Papua, for the additional specimens of *Strombus* (*Dolomena*) *kleckhamae* collected by him on Matupi Island.

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INDO-PACIFIC PISANIINAE (MOLLUSCA: GASTROPODA) AND RELATED BUCCINID GENERA

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Abstract. Genus-groups of the subfamily Pisaniinae and their relationship to other buccinid genera are evaluated. Species of Buccinidae living in the Fiji Islands are described and illustrated.

During a study of Pacific Buccinidae, their shells and radulae, it became apparent that several genus-groups proposed for Indo-Pacific buccinid species appeared to be superfluous. Comparisons of radulae and morphological characters of Indo-Pacific species, demonstrate a close relationship between several genera of the subfamily Pisaniinae. Some of the currently accepted names of buccinid species were found to be primary or secondary homonyms and had to be replaced by new combinations from available synonyms.

Family BUCCINIDAE Rafinesque, 1815 (ex-Buccinidia)

Photidae Kobelt, 1881, Syst. Conch. Cab., *Buccinum*, ed. 2, 3(1) : 1; Cooke, 1917, Proc. Malac. Soc. Lond. 12 : 237; Rippingale & McMichael, 1961, Old. Gt. Barrier reef shells, p. 109; Iredale & McMichael, 1962, Mem. Aust. Mus. 11 : 69 (ex-Photina Troschel, 1867).

Pisaniidae Locard, 1897, Exp. sci. Trav. "Talisman", 1 :320 (ex-Pisaniinae Tryon, 1881).

Buccinulidae Finlay, 1928, Trans. Proc. N.Z. Inst. 59 :250.

Cominellidae Powell, 1929, Trans. Proc. N.Z. Inst. 60: 59 (ex-Cominellinae Cossmann, 1901.

Austrosiphonidae Cotton & Godfrey, 1938, Malac. Soc. Sth. Aust. Publ. No. 1: 24.

Pusiostomatidae Iredale, 1940, Aust. Zool. 9(4): 434 (for *Engina* group of species).

Several closely related genera have been segregated in separate families without documented proof that such an elevation in rank is biologically imperative. The classification of genera has been largely based on either common diagnostic shell-features or differences in dentition, and in some instances geographical distribution. As far as the dentition is concerned, some workers have placed more reliance on the shape and number of cusps of the rachidian teeth, while other investigators considered the laterals to be of diagnostic importance.

A classification of buccinid genera based entirely on radula features would in many instances produce incongruous results through combinations of genera which do not appear to be closely related at all. Tropical Indo-Pacific Pisaniinae of the *Pisania-Acamptochetus* group share the same type of rachidian with the temperate water genera *Buccinulum, Euthria* and juvenile specimens of *Burnupena*. With the exception of *Burnupena* and partly the subfamily Photinae, lateral

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teeth in Buccinidae are variously modified types of a prototypic tricuspid lateral; these modifications are not confined to a particular genus and appear sporadically in various genera. The conclusion is, that the buccinid radula is often more reliable in distinguishing between species than it is in separating genera.

Subfamily PISANIINAE Tryon, 1881

Pisaniinae Tryon, 1881, Man. Conch. 3 :98.

Shell small to medium in size, 10-50 mm, fusiformly-ovate to fusiformly elongate; smooth or sculptured with spiral threads, cords, axial striae or granules. Aperture narrow, elliptical or fusiform, labial lip often exteriorly thickened by a varix, interiorly smooth or finely denticulate; columella calloused, parietal wall with or without a distinct denticle, sometimes denticulate along entire length of the columella, anterior end of columella frequently with an angular projection. Labial denticles continuing for a short distance into aperture, siphonal canal moderately short but distinct.

The radula of Pisaniinae consists of square to shortly rectangular rachidians with 3-5 cusps; in some species the cusps are obsolete and indicated by axially incised, blunt denticles. The operculum is corneous, with a basal nucleus.

Genus **Pisania** Bivona, 1832

Pisania Bivona, 1832, Effem. Sci. Lett. Sicil. Palermo 2 :8. Type species by SD (Pace, 1902) *P.striatula* Bivona, 1832 = *Murex striata* Gmelin, 1791. Recent, Mediterranean.

1850. *Polliana* E. M. Gray, Figs. Moll. Anim. 5 :67 (publ. in synonomy of *Pisania* Bivona)

1904. *Taeniola* Dall, Smiths. Misc. coll. 47: 137. Type species by OD *Triton decollatus* Sowerby, 1833. Recent, Pacific. (non Pallas, 1760).

1924. *Prodotia* Dall, Proc. Biol. Soc. Washington 37 :89. Type species by OD *Pisania billeheusti* Souverbie (= Petit de la Saussaye) = *Buccinum gracile* Reeve, 1846. Recent, Indo-Pacific.

1929. *Appisania* Thiele, Handb. syst. Weicht., p. 314. Type species by M *Metula (Appisania) montrouzieri* Crosse = *Pisania crenilabrum* A. Adams, 1855. Recent, Indo-Pacific.

1966. *Sukunaia* Cernohorsky, Veliger 9(2) : 229. Type species by OD *S.jenningsi* Cernohorsky, 1966. Recent, Pacific.

Pisania crenilabrum A.Adams, 1855 (Figs. 3-9, 18, 30)

1855. *Pisania crenilabrum* A. Adams, Proc. Zool. Soc. Lond. p. 138.

1862. *Pisania montrouzieri* Crosse, J. Conchyl. 10 :251, pl. 10, fig. 5 (New Caledonia).

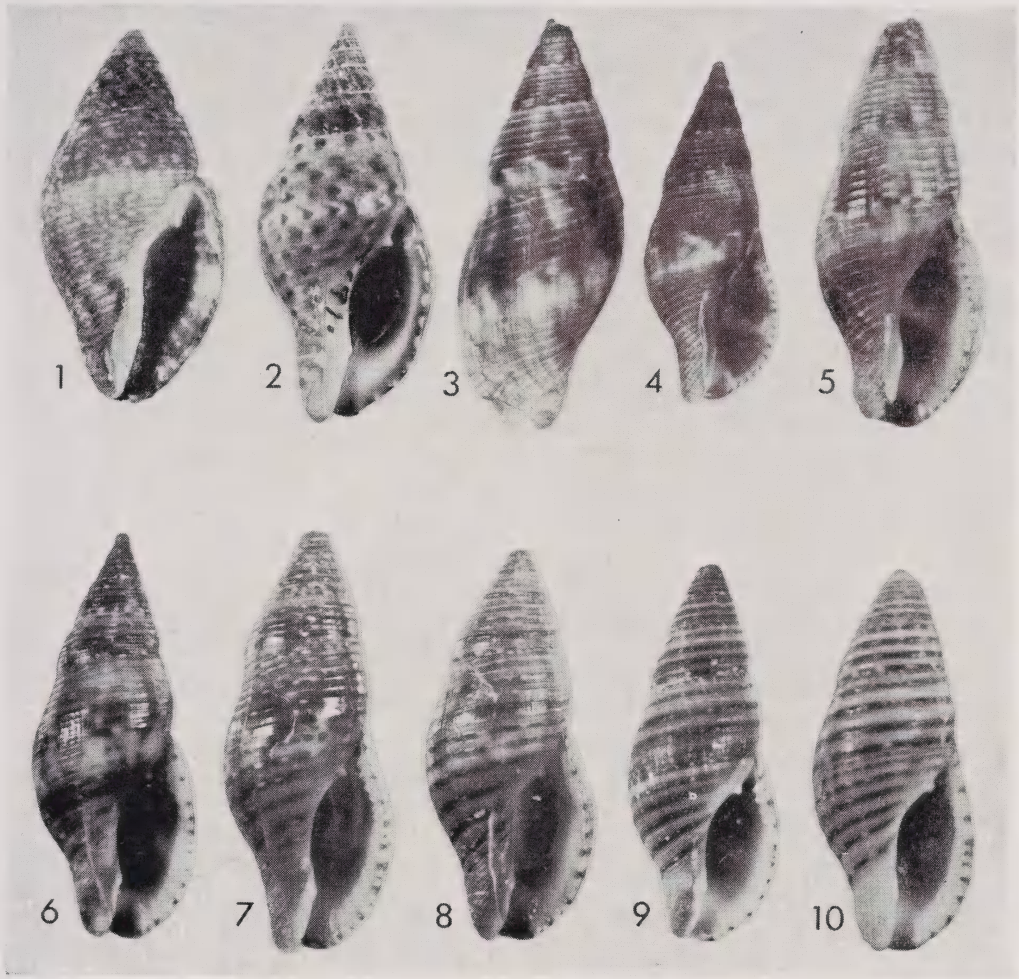
1903. *Pisania crenilabrum* Adams, E. A. Smith, Proc. Malac. Soc. Lond. 5 :372.

1929. *Metula (Appisania) montrouzieri* Crosse, Thiele, Handb. syst. Weicht. 1 :314, fig. 347.

1966. *Appisania montrouzieri* (Crosse), Cernohorsky, Veliger 9(2) : 232, pl. 20, figs. 5-8.

TYPE LOCALITY: West Indies —error! (New Caledonia for *P.montrouzieri*).

Smith (1903) drew attention to the fact that Adams' locality indication for *P.crenilabrum* was an error. During an examination of the types of *P.crenilabrum* at the British Museum (Nat.Hist.), London, the present author found *P.crenilabrum* to be the same species as *P.montrouzieri*. The 3 syntypes of *P.crenilabrum* have the following dimensions: 1) length 24.8 mm, width 10.4 mm, height of aperture 13.4 mm (here selected as the lectotype); 2) length 21.2 mm, width 8.5 mm, height of aperture 11.2 mm; 3) length 20.9 mm, width 8.1 mm, height of aperture 10.8 mm. The smallest specimen is immature and the protoconchs are missing in the large adult specimens.



Figs. 1-10. Shells. 1. *Pisania striata* (Gmelin). Malta; length 21.8mm. 2. *P. pusio* (Linnaeus). Pelican Shoals, Florida; length 21.8mm. 3-9. *P. crenilabrum* A. Adams. West Indies (error! = Indo-Pacific). 3. Lectotype B.M.N.H.; length 24.8mm. 4. Syntype B.M.N.H.; length 20.9mm (immature). 5. Northwest Island, Queensland, Australia, intertidal; length 20.2mm. 6 . Viti Levu Bay, Fiji I., intertidal; length 23.7mm. 7. Suva reef, Fiji I., intertidal; length 27.6mm. 8. Hazlewood I., Whitsunday Group, Queensland, Australia, intertidal; length 21.3mm. 9. Rat Tail Passage, Suva, Fiji I., intertidal; length 28.8mm. 10. *P. fasciculata* (Reeve). Davao, Mindanao, Philippine I.; USNM No. 231048; length 27.2mm.

The species is variable in colour, being either brown, reddish-brown, grey or purplish, and is occasionally ornamented with axial streaks and small white spots on the spiral striae; in some specimens the dark axial zones and white spots are absent. Some specimens closely resemble *Buccinum tritonoides* Reeve, 1846, described from the Island of Ticao, Philippines. The radula of *"Ecmanis tritonoides* Reeve" as figured by Habe (1958,pl.3,fig.10), is the radula of a *Cantharus* or *Pollia,* while the specimen illustrated by Habe & Kosuge (1967, pl.31, fig.13) as *"Ecmanis tritonoides"* appears to be a different species. *Appisania sugimotoi* Habe, 1968, from Japan, is very similar to *P.crenilabrum* and differs only in colour.

Pisania crenilabrum A.Adams, is the type species of *Appisania* Thiele,1929, originally proposed as a section of *Metula* H .& A .Adams.

Pisania fasciculata (Reeve, 1846) (Fig. 10)

1834. ?*Triton (Pusio) vexillum* Gray in Griffith & Pidgeon, Anim. King. Moll. Rad. Cuvier, 12. pl. 37, fig. 5.

1846. *Buccinum fasciculatum* Reeve, Conch. Icon., pl. 10, sp. 76.

1966. *Appisania fasciculata* (Reeve), Cernohorsky, Veliger 9(2) : 232, pl. 20, fig. 9.

TYPE LOCALITY: Island of Mindanao, Philippines.

This species is rather similar in general appearance to *P.crenilabrum,* but the spiral striae are less numerous, wider spaced and thicker; the base colour is white or creamy-yellow, and the cords are reddish-brown and occasionally spotted with white.

Triton (Pusio) vexillum Gray in Griffith & Pidgeon, is an undetermined species which closely resembles beach-worn specimens of *Pisania fasciculata.*

Future population studies of the closely related *P.fasciculata* and *P.crenilabrum* may show that the two species are conspecific. The present author has observed intergrading specimens from the Tonga Islands, Fiji and N.E. Australia.

Pisania decollata (Sowerby, 1833) (Figs. 13-14, 19, 31)

1833. *Triton decollatus* Sowerby, Proc. Zool. Soc. Lond., pt. 1 : 72.

1844. *Triton decollatus* Sowerby, Reeve, Conch. Icon., *Triton,* pl. 18, sp. 82.

1863. *Pisania strigata* Pease, Proc. Zool. Soc. Lond. 1862 : 241 (Pacific Islands).

1868. *Pisania strigata* Pease, Amer. J. Conch. 4(3) : 93, pl. 11, fig. 6 (Ponape I., Caroline Islds.).

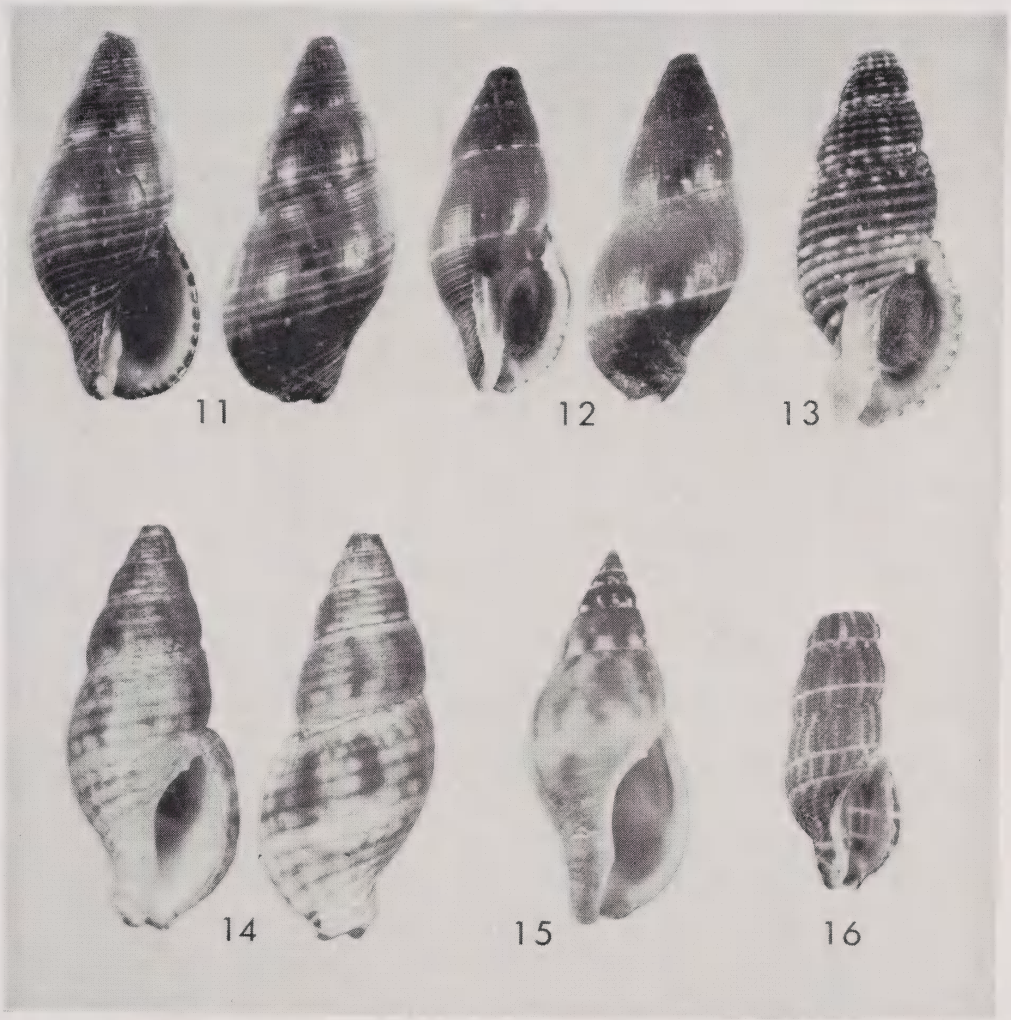
1965. *Pisania strigata* Pease, Kay, Bull. Brit. Mus. (Nat. Hist.), Zool. Suppl. 1 :72, pl. 12, figs. 16, 17.

TYPE LOCALITY: Anaa Island, Tuamotu Archipelago.

The colouring of the species is reminiscent of *Cymatium hepaticum* (Röding): the prominent spiral cords are reddish-orange in colour and granose, and the interstices are blackish-brown, spirally lirate and axially decussate; small white spots or blotches are irregularly distributed over the whorls. The labial varix and columellar shield are prominent, the anterior of the columella has 2-3 irregular denticles and the labial lip is denticulate. The protoconch is immersed in the teleconch in adult specimens. The operculum is light brown, with a basal nucleus. The radula (Fig. 19) is similar to the radula of *Pisania crenilabrum;* the small central denticle of the lateral is at times obsolete or missing.

The lectotype of *Pisania strigata* Pease, is in the British Museum (Nat.Hist.), London, No.1964288. The dimensions are length 33.4 mm, width 13.7 mm, height of aperture 17.0 mm; the type is worn, faded and not fully mature. *P.decollata* appears to be confined to the Pacific region.

Pisania decollata (Sowerby) is the type species of *Taeniola* Dall, 1904, originally proposed as a genus-group in the taenioglossate Cymatiidae. *Taeniolo* Dall, is a homonym of *Taeniola* Pallas, 1760.



Figs. 11-16. Shells. 11. *Pisania jenningsi* (Cernohorsky). Naevuevu, Fiji I., intertidal; holotype USNM No. 673301; length 23.2mm. 12. *P. luctuosa* Tapparone-Canefri. Tavarua I., W. off Viti Levu, Fiji I., intertidal; length 18.7mm. 13, 14. *P. decollata* (Sowerby). 13. Rat Tail Passage, Suva, Fiji I., intertidal; length 23.0mm. 14. Lectotype of *P. strigata* Pease. Pacific Islands. B.M.N.H. No. 1964288; length 33.4mm (beach-worn and faded). 15. *P. (Ecmanis) ignea* (Gmelin). Rat Tail Passage, Suva, Fiji I., intertidal; length 22.0mm. 16. *P. (Caducifer) truncata* (Hinds). Rat Tail Passage, Suva, Fiji I., intertidal; length 15.0mm.

Pisania jenningsi (Cernohorsky, 1966) (Figs. 11, 22)

1966. *Sukunaia jenningsi* Cernohorsky, Veliger 9(2) : 299, pl. 20, figs. 1-4.

TYPE LOCALITY: Naevuevu village, Southwest Viti Levu, Fiji Islands.

The species is more inflated and bulbous than other *Pisania* species and almost smooth apart from a few irregular fine striae; the columellar shield is ill-developed and only visible anteriorly, the aperture is wide and oval and the labial denticles are blunt and obsolete.

The radula (Fig. 22) has tricuspid laterals similar to those of *Pisania,* and the rachidians have obsolete denticles which rarely protrude over the margin of the plate. The operculum is light brown with 2 purplish-black axial zones and a basal nucleus.

The unusual and cuspless rachidians of the radula previously prompted the present author (1966) to propose the genus *Sukunaia* for this species, since this type of rachidian has not previously been recorded in the Buccinidae. The discovery of the same type of cuspless rachidian in the species *Pisania marmorata* (Reeve) [= *P.gracilis Reeve*] a species similar in appearance to *Pisania* but with a granose sculpture, demonstrates the variability of rachidians within species of the same genus. The differences in shell-characters between *P.jenningsi* and other species of Pisaniinae are in itself insufficient for a retention of *Sukunaia* as a genus-group.

Pisania luctuosa Tapparone-Canefri, 1875 (Figs. 12, 23-26, 33-34)

1875. *Pisania luctuosa* Tapparone-Canefri, Boll. Soc. Malac. Ital. 2:242 (Mauritius).

1880. *Pisania luctuosa* Tapparone-Canefri, Ann. Soc. Malac. Belg. 15(1) : 60, pl. 2, figs. 7-9.

1967. *Pisania fasciculata* (Reeve), Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119(4) : 135, pl. 13, fig. A (non *Buccinum fasciculatum* Reeve, 1846) Cocos-Keeling I.

Shell moderately small, 12-20 mm in length, slender and elongate, width 42%-48% of length; blackish-brown or dark purple-black in colour, ornamented with a narrow, white peripheral band on body whorl from which short white lines extend in direction of suture; on penultimate whorl small white spots occasionally visible at suture. Teleoconch of $3\frac{3}{4}$ - $4\frac{1}{4}$ mature whorls in adult specimens, protoconch of 1 single turn immersed within teleoconch; in juvenile specimens teleoconch of 5 mature whorls and protoconch of 3 brown, axially striate nuclear whorls, with the initial turn white. Sculptured with numerous, fine and irregular spiral striae numbering 16-23 on penultimate whorl and 36-50 on body whorl some spirals more prominent than others and early whorls costate. Aperture narrow, equal in height or longer than spire, elliptical, bluish-white or light violet within, labial lip externally thickened and internally with 13-16 white denticles; the first 2-3 posterior denticles thickened and projecting, remaining denticles become progressively smaller towards siphonal canal. Columella calloused anteriorly, purplish-brown in colour, parietal wall with a distinct denticle, anterior of columella with a blunt projecting notch-like denticle; siphonal canal short but distinct.

The operculum (Fig. 24) is corneous, yellowish-brown in colour and with a dark brown axial zone, nucleus basal but indistinct. The rachidians of the radula (Figs. 23-25) are shortly rectangular, with a concave base and 5 cusps. The laterals are similar to *Pisania crenilabrum,* with a massive inward pointing inner cusp of variable length, and a small distinct or almost obsolete central cusp and a short, hooked back cusp. Sexual dimorphism was evident in the radulae of *P.luctuosa* (Table 1): the females have an appreciably shorter and narrow odontophore, but more numerous rows of teeth.

The living animal's dorsal side of the foot is creamy-white, mottled with blackish-brown, the sole of the foot is creamy-white and iridescent. The siphon is very long and a delicate shade of pink.

Pisania luctuosa is similar to P.*crenilabrum* A. Adams, with which species it is sympatric in Fiji and Mauritius, without any integrading specimens having been encountered. *Pisania luctuosa,* apart from the distinctive colour pattern, differs in features of small size, slender form, narrower aperture and more numerous spiral striae. The operculum of *P.crenilabrum* is uniformly fawn or light orange-brown in colour, and lacks the purplish-brown zones within the centre. The rachidians of the radula in *P.crenilabrum* are trapezoidal, with the sides ascending obliquely towards the base of the plate.

Pisania luctuosa has an Indo-Pacific distribution. Apart from the type locality of Mauritius, the species has been recorded by Orr-Maes (1967) from the Indian Ocean Cocos-Keeling Islands (as *P.fasciculata* Reeve). In the Fiji Islands the species has been collected at Rat Tail Passage, Sth. Viti Levu (leg. W. Cernohorsky), Tavarua I., W. Viti Levu (A. Jennings and W. Cernohorsky), and the Momi shore reef (A. Jennings). A specimen of *P.luctuosa* from Port Moresby, Papua & New Guinea (leg. F. Kleckham, intertidal on reef), has also been examined.

Table 1. Sexual dimorphism in the radulae of *Pisania luctuosa* Tapparone-Canefri.

Length of shell (mm)	Sex	Length of radula (mm)	Length of radula in % of shell length	Width of radula (mm)	Width of radula in % of shell length	No. of rows of teeth (nascentes in brackets)	No. of rows of teeth per 1mm of radula length	Locality
17.9	♂	13.0	73	0.50	2.8	118 (+ 7)	9.1	Tavarua Island
16.8	♂	12.1	72	0.44	2.6	120 (+ 8)	9.9	„
16.2	♂	10.7	66	0.44	2.7	102 (+ 5)	9.5	„
17.7	♀	10.1	57	0.34	1.9	146 (+ 8)	14.6	„
17.0	♀	9.0	53	0.28	1.6	147 (+ 8)	19.3	„
16.5	♀	8.7	53	0.32	1.9	144 (+ 6)	16.6	„
15.5	♀	9.2	59	0.29	1.9	153 (+ 9)	16.6	„
14.4	♀	8.0	55	0.26	1.8	148 (+ 7)	18.5	Momi reef
12.6	♀	7.8	62	0.24	1.9	146 (+ 10)	18.7	Port Moresby

Pisania gracilis (Reeve, 1846) (Figs. 21, 32, 41-44)

1846. *Buccinum marmoratum* Reeve, Conch. Icon., pl. 12, sp. 95 (Island of Capul, Philippines) [non Link, 1807; nec Anton, 1839].

1846. *Buccinum gracile* Reeve, Conch. Icon., pl. 12, sp. 96.

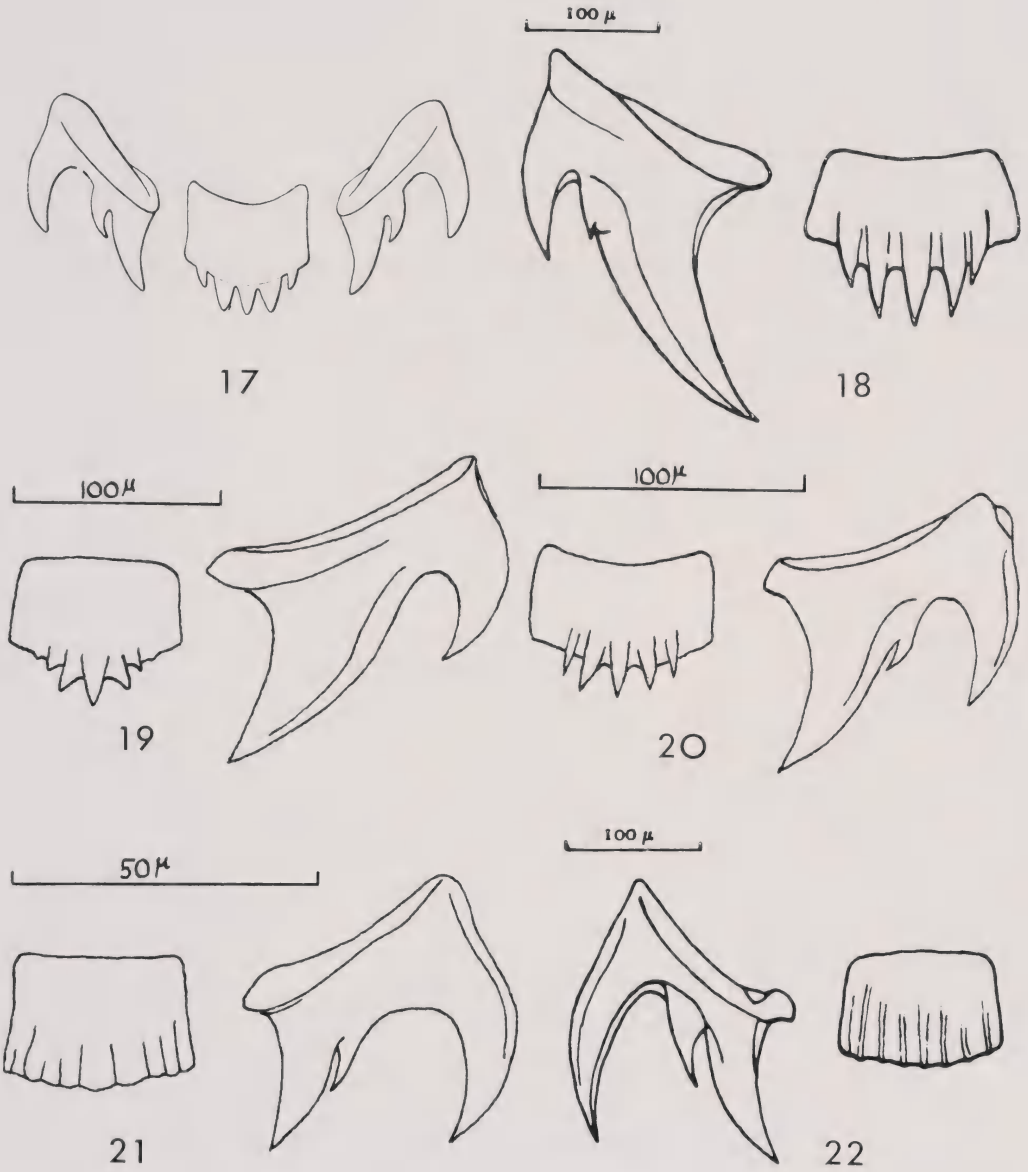
1846. *?Buccinum crocatum* Reeve, Conch. Icon., pl. 12, sp. 97 (Island of Capul, Philippines).

1853. *Phos billeheusti* Petit de la Saussaye, J. Conchyl. 4(3) : 244, pl. 8, fig. 5 (Nukuhiva I., Marquesas Islands).

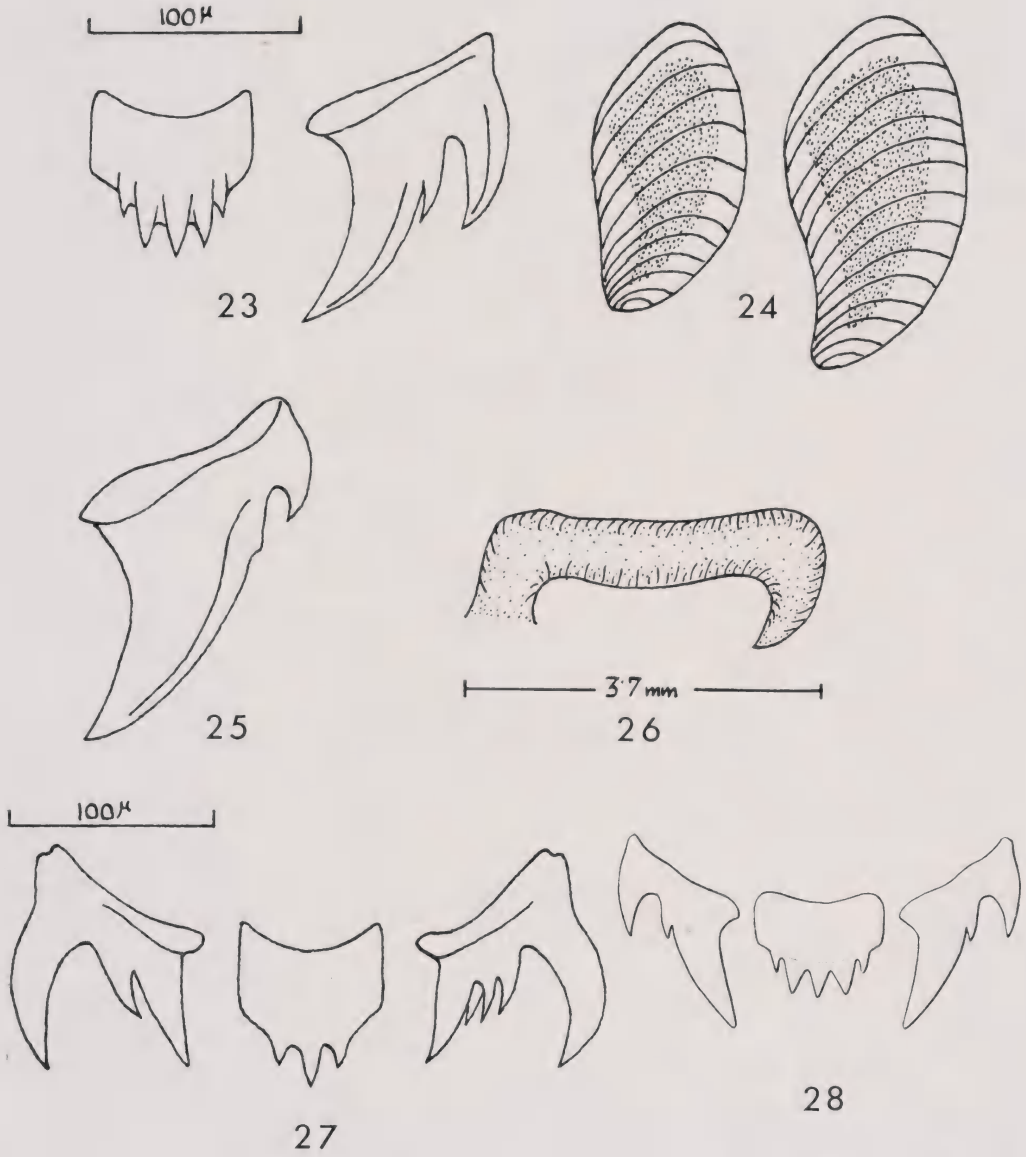
1967. *Pisania marmorata* (Reeve), Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119(4) : 135, pl. 13, fig. B (non *Buccinum marmoratum* Link, 1807).

TYPE LOCALITY: Island of Masbate, Philippines.

The well-known Indo-Pacific species *Buccinum marmoratum* Reeve, is twice pre-occupied and will have to be replaced by *Buccinum gracile*. The three syntypes of *B.marmoratum* Reeve, are in the British Museum (Nat.Hist.),



Figs. 17-22. Radulae. 17. *Pisania striata* (Gmelin). Mediterranean. (From Troschel, 1867, pl. 7, fig. 2.) 18. *P. crenilabrum* A. Adams. Northwest I., Queensland, Australia. 19. *P. decollata* (Sowerby). Rat Tail Passage, Suva, Fiji I. 20. *P. (Ecmanis) ignea* (Gmelin). Rat Tail Passage, Suva, Fiji I. 21. *P. gracilis* (Reeve). Suva reef, Fiji I. 22. *P. jenningsi* (Cernohorsky). Naevuevu, Fiji I.



Figs. 23-28. Radulae. 23-26. *Pisania luctuosa* Tapparone-Canefri. Tavarua I., Fiji I. 23. Half-row of radula. 24. Opercula. 25. Lateral tooth of radula. 26. Penis. 27. *P. (Caducifer) truncata* (Hinds). Rat Tail Passage, Suva, Fiji I. 28. *Acamptochetus mitrella* (Adams & Reeve). Philippines. (From Troschel, 1867, pl. 7, fig. 10.)

London; they are large but immature specimens with not fully developed labial denticles and measure 32.2 mm, 31.4 mm and 25.6 mm in length. The largest specimen, i.e. 32.2 mm in length, which has been figured by Reeve (1846, pl.12, sp.95) is here selected as the lectotype of *B.marmoratum.* Slender and slightly broader individuals are found in all populations of *Pisania gracilis,* and immature specimens, such as Reeve's *Buccinum marmoratum,* are always disproportionately broad. *Phos billeheusti* Petit de la Saussaye, has been based on the slender form of *Pisana gracilis.*

The rachidians of the radula of *P.gracilis* (Fig. 21) has the same obsolete denticles as are found in *P.jenningsi,* while the laterals are of the same type as in *P.striata* (Gmelin). It is very doubtful that the radula of *"Engina(?)marmorata"* from the Seychelles Islands, as figured by Peile (1939, fig. 39) has been extracted from the species under discussion; both, rachidians and laterals, indicate that Peile's species was a typical *Engina.*

Pisania gracilis (Reeve), is the type species (as *P.billeheusti*) of *Prodotia* Dall, 1924; apart from the granose sculpture, there is little else on which to base a generic separation from *Pisania. Buccinum crocatum* Reeve, may prove to be only a colour variant of *Pisania gracilis.*

Subgenus **Ecmanis** Gistl, 1848

Ecmanis Gistl, 1848, Nat. Thierr. Schulen, p. 10. Type species (art. 67 (i) of ICZN) *Buccinum igneum* Gmelin, 1791. Recent, Indo-Pacific *(Nom. subst. pro Proboscidea* Schmidt in Möller, 1832).

1832. *Proboscidea* Schmidt in Möller, Isis, col. 131. Type species by M. *P. ignea* = *Buccinum igneum* Gmelin, 1791 (non *Proboscidea* Bruguière, 1791; nec Spix, 1824).

The shell is similar in form to *Pisania,* but thinner and more fragile and inflated, with the labial denticles obsolete in adult specimens. The operculum is light yellowish-brown in colour, with a basal nucleus. The radula (Fig. 20) is similar to the radula of *Pisania striata,* except that the inner cusp of the laterals is slightly longer. The subgenus appears to be monotypic, and is confined to the Indo-Pacific region.

Pisania (Ecmanis) ignea (Gmelin, 1791) (Figs. 15, 20, 35)

1780. *"Triton buccinulum nitidissimum* Chemnitz", Syst. Conch. Cab. 4 :72, pl. 127, fig. 1217 *(non binom).* [Cape of Good Hope].

1791. *Buccinum igneum* Gmelin, Syst. Nat., ed. 13, pl. 3494 (ref. Chemnitz, *op. cit.,* fig. 1217 (Hab : ?).

1798. *Tritonium buccinulum* Röding, Mus. Bolten., p. 125 (ref. Chemnitz, *op. cit.,* fig. 1217).

1833. *Buccinum flammulatum* Quoy & Gaimard, Voy. Astrolabe 2: 426, pl. 30, figs. 29-31 (Tongatabu).

1846. *Buccinum pictum* Reeve, Conch. Icon., pl. 10, fig. 74 (Isle of Capul, Philippines).

TYPE LOCALITY: *None.* (Cape of Good Hope — Chemnitz, 1780).

This species differs from other *Pisania* species by its light weight in proportion to shell size and fragile appearance. In the most senile specimens, only the first posterior labial denticles are distinct, and are followed by 4-5 blunt, almost obsolete denticles which are indicated as swellings. The early whorls are prominently granulose, but the last two whorls have only obsolete spiral threads or grooves.

The radula of *Ecmanis ignea* as figured by Habe & Kosuge (1967,p.79,bottom figure), is appreciably different to the radula extracted from Fiji specimens (Fig. 20), and resembles the radula of *Engina*. The type locality of Cape of Good Hope may be an error, as the species does not appear to be listed in South African faunal records.

Subgenus **Caducifer** Dall, 1904

Caducifer Dall, 1904, Smiths. Misc. coll. 47 :136. Type species by OD *Triton truncatus* Hinds, 1844. Recent, Indo-Pacific.

In sculpture and apertural features *Caducifer* is similar to *Pisania,* but differs in the slender, terebriform shape and short aperture. In adult specimens the protoconch is immersed in the teleoconch in a similar manner as in *Pisania decollata, P.crenilabrum* and *P.luctuosa.*

The radula of *Caducifer* (Fig. 27) is similar to the radula of *Pisania striata* (Gmelin), except that the rachidians have only 3 cusps instead of 5; the number of cusps on the laterals is variable, and fluctuates between 3 and 5.

Pisania (Caducifer) truncata (Hinds, 1844) (Figs. 16, 27)

1844. *Triton truncatus* Hinds, Proc. Zool. Soc. Lond. 12 :21.

1844. *Triton truncatus* Hinds, Zool. Voy. Sulphur 2 : pl. 4, figs. 9, 10.

1844. *Triton decapitatus* Reeve, Conch. Icon., pl. 18, sp. 85 (Island of Burias, Philippines).

1868. *Triton cylindricus* Pease, Amer. J. Conch. 4(3) : 94, pl. 11, fig. 8. (Tahiti).

1904. *Tritonidea (Caducifer) decapitata* (Reeve), Pilsbry & Vanatta, Proc. Acad. Nat. Sci. Philad. 56 :594, fig. 4 (radula).

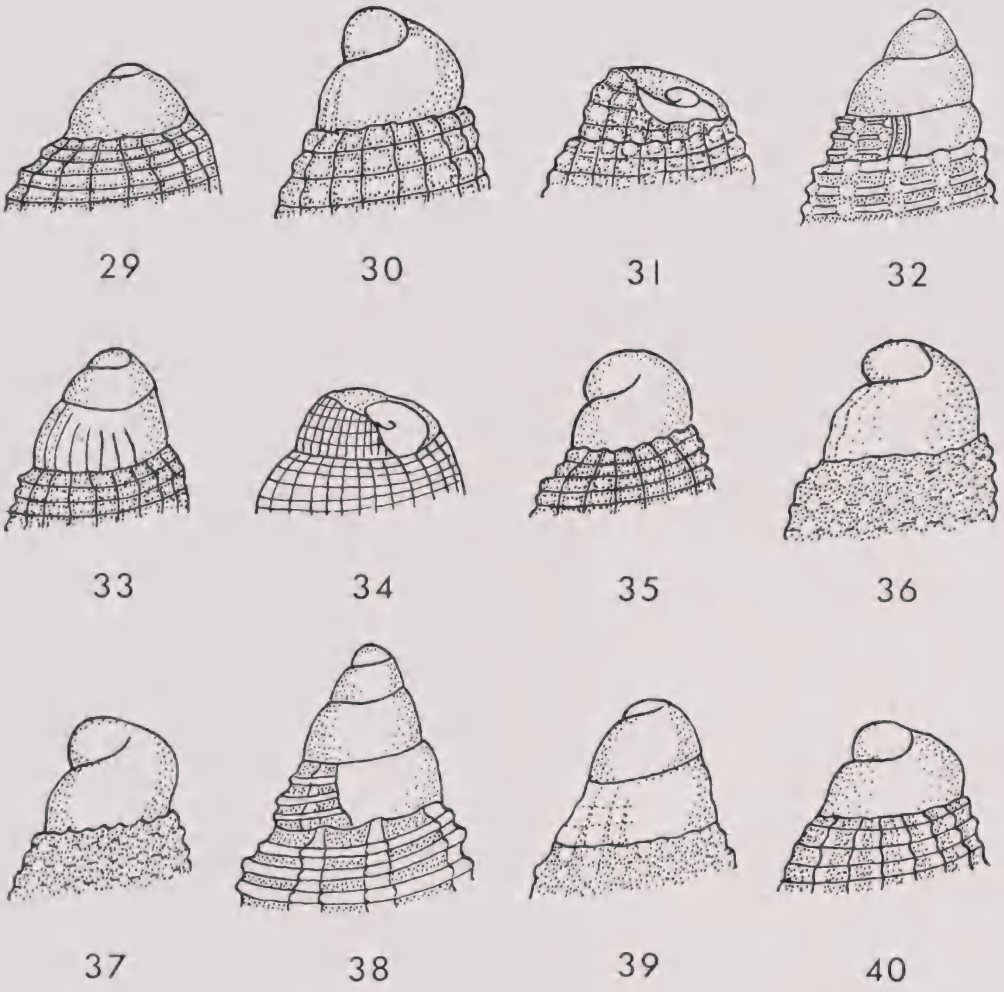
TYPE LOCALITY: New Ireland.

The species is closely allied to the *Pisania* group of species, but is more terebriform, the aperture is shorter and the labial denticles are fewer in number and more widely spaced. The species is variable in colour, but is generally leaden-grey or brown, and ornamented with spiral and axial white lines.

Subgenus **Jeannea** Iredale, 1912

Jeannea Iredale, 1912, Proc. Malac. Soc. Lond. 10 :220. Type species by OD *J.hedleyi* Iredale, 1912. Recent, Kermadec Islands.

The type species is very similar to other tropical *Pisania* species, and differs only in the smaller, weaker and slightly more numerous labial denticles. The operculum is yellowish-orange in colour, with a basal nucleus. Most specimens of



Figs 29-40. Protoconchs. 29. *Pisania striata* (Gmelin). 30. *P. crenilabrum* A. Adams (juvenile). 31. *P. decollata* (Sowerby). 32. *P. gracilis* (Reeve). 33, 34. *P. luctuosa* Tapparone-Canefri. 33. Juvenile. 34. Adult. 35. *P. (Ecmanis) ignea* (Gmelin). 36. *Cantharus (Pollia) undosus* (Linnaeus). 37. *C. (P.) subrubiginosus* (E. A. Smith). 38. *C. (P.) pulcher* (Reeve). 39. *Engina alveolata* (Kiener). 40. *Jeannea hedleyi* Iredale.

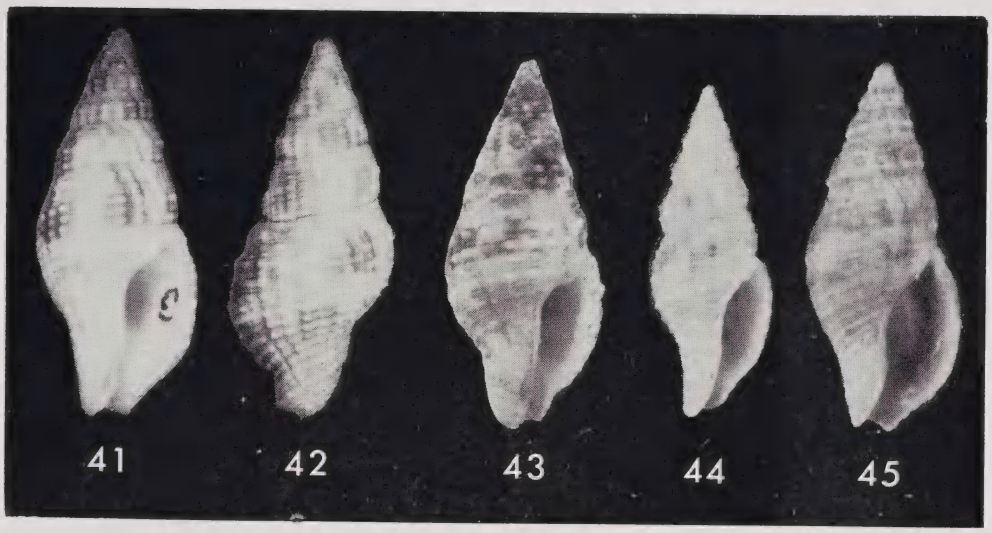
Pisania(Jeannea)hedleyi (Figs. 40,45) also retain their protoconch in the adult stage.

Because of the close conchological resemblance of *P. (J.) hedleyi* to other *Pisania* species, *Jeannea* is retained as a subgenus pending the availability of a radula for examination.

THE METULA-RATIFUSUS SERIES

Genus **Metula** H. & A. Adams, 1853

Metula H. & A. Adams, 1853, Gen. Rec. Moll. 1 : 84. Type species by SD (Kobelt, 1876)



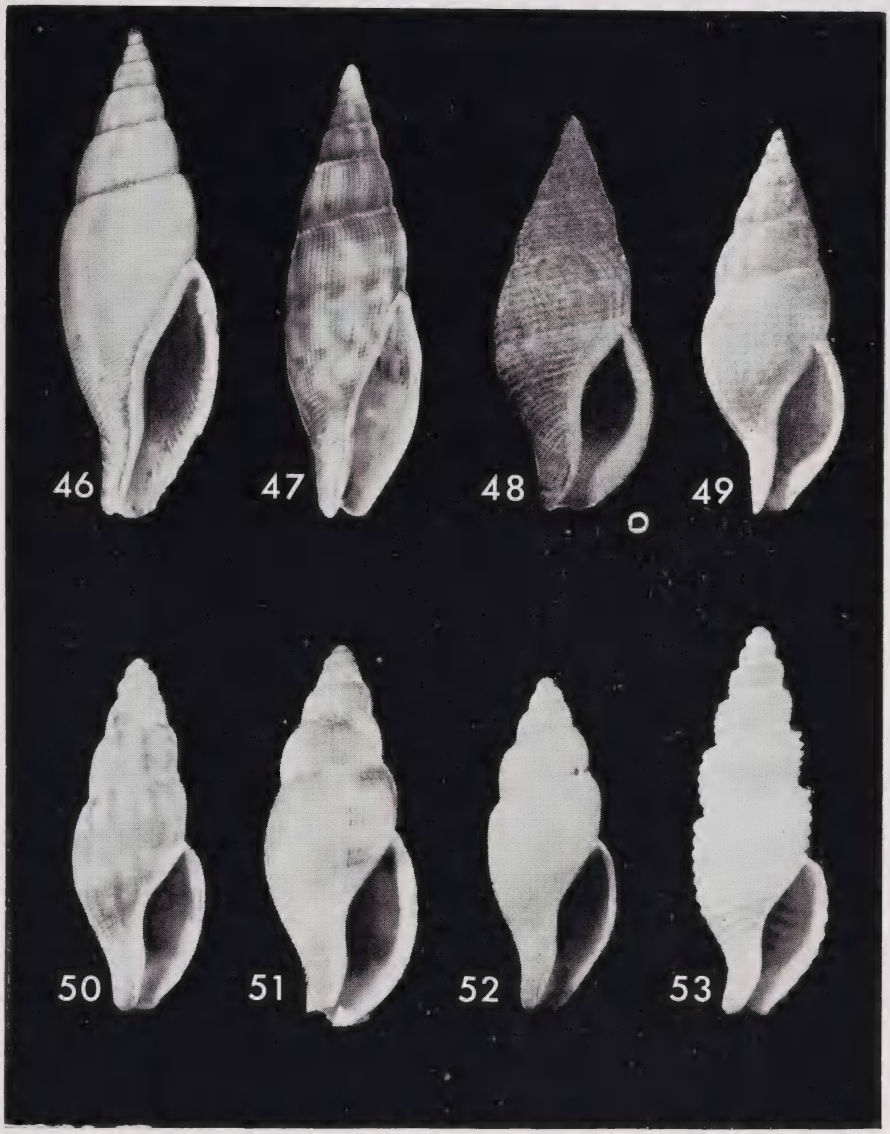
Figs. 41-45. Shells. 41-44. *Pisania gracilis* (Reeve). 41. Lectotype of *Buccinum marmoratum* Reeve, Island of Capul, Philippines; B.M.N.H., length 32.2mm. 42. Syntype of *B. marmoratum* Reeve, B.M.N.H.; length 31.4mm. 43. *Pisania gracilis* (Reeve). Rat Tail Passage, Suva, Fiji I., intertidal; length 19.3mm (broad form). 44. *P. gracilis* (Reeve). Rat Tail Passage, Suva, Fiji I., intertidal; length 17.6mm (slender form). 45. *Jeannea hedleyi* Iredale. Kermadec Islands; length 11.8mm.

M.clathrata Adams & Reeve = *Buccinum clathratum* Adams & Reeve, 1850 (non Kiener, 1834; nec Anton, 1839). Recent, Cape of Good Hope, Sth. Africa (error! – fide Tomlin, 1927 = Gorgona I., off the Colombian coast, W. coast America).

Keen (1958) and Woodring (1964) considered *Buccinum metula* Hinds, to be the type species by hidden tautonymy. The current edition of the Code does not provide for a type designation by hidden tautonymy, and since *Buccinum metula* was not an originally included species (art. 68(d)) of ICZN), a type designation by tautonymy must be excluded.

Rehder (1943) treated the *Metula* problem in detail, and proposed *Antemetula* for the *Metula* auct. with *Buccinum metula* Hinds, as the type species. *Antemetula* Rehder, is in the opinion of the present author congeneric with *Acamptochetus* Cossmann, 1901.

The status of *Metula* depends on whether the species assigned to *Acamptochetus* and *Metula* are generically distinct, and also what the identity of *Buccinum clathratum* Adams & Reeve, the type species of *Metula,* really is. *Buccinum clathratum* Adams & Reeve, was originally described from the Cape of Good Hope, but Tomlin (1927) considered this locality erroneous, and confirmed the species occurrence from off the Columbian coast and Balboa. Keen (loc. cit), however, omitted the species from the West American fauna, and as far as could be ascertained, the species has remained unfigured since its description. The original describers provided a moderately reasonable figure of a species which could be referable to *Metula* as presently understood. This particular figure bears a great resemblance in form, sculpture and apertural features to the Miocene *Metula gabbi* Brown & Pilsbry, from the Panama Canal Zone, as figured by Woodring (1964, pl. 40, figs. 18, 19), except that the sculpture in the Miocene species is



Figs. 46-53. Shells. 46. *Acamptochetus mitraeformis* (Brocchi). Piedmont, U. Miocene of Italy; length 39.4mm. 47. *A. mitrella* (Adams & Reeve). Tayabas Bay, Marinduque, Philippine I., deep water trawl; length 31.5mm. 48. *Bartschia significans* Rehder. Off the Tortugas, Florida; length 54.5mm (from Rehder, 1943, pl. 20, fig. 17). 49. *Kanamarua adonis* (Dall). Enshu-nada, Japan (from Oyama & Takemura, 1958, pl. 19, fig. 3). 50. *Ratifusus adjunctus* Iredale. Off Aldermen I., New Zealand, in 200-260f (366-476m); length 19.0mm. 51. *R. reticulatus* (A. Adams). Off Schooner Bay, Gt Barrier I., New Zealand, in 15 fathoms (27m); length 21.0mm. 52. *R. (Iredalula) striatus* (Hutton). Bay of Plenty, New Zealand, deep water trawl; length 17.8mm. 53. *R. (Iredalula) alticinctus* (Murdoch & Suter). Off Aldermen I., New Zealand, in 260f (476m); length 21.5mm.

somewhat finer. Only an examination of Adams & Reeve's type of *Buccinum clathratum* and Tomlin's specimens of the species from West America, may help to elucidate the status of *Metula* and *Buccinum clathratum*, which, to complicate matters, is twice pre-occupied.

The *Metula - Acamptochetus* group of species is characterized by slender, elongate-ovate to fusiformly-ovate shells, which have a finely granose sculpture consisting of intersecting spirals and axials, and occasionally a cingulate or smooth thread at the sutures; the aperture is narrow and fusiform, the labial denticles are either obsolete or distinct and elongate, and the columella is smooth and has a narrow callus; in some species, whorls have adpressed, growth-varices.

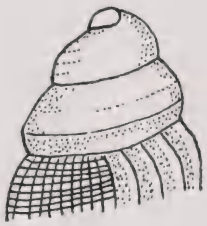
The genus *Bartschia* Rehder, 1943 (type species *B.significans* Rehder, 1943 — Florida-Caribbean), should be located in the Pisaniinae, near the *Metula* group. *Monostiolum* Dall, 1904 (type species *Triton swifti* Tryon — Caribbean), should be removed from the Colubrariidae and located in the Buccinidae, possibly the Pisaniinae subfamily.

Genus **Acamptochetus** Cossmann, 1901

Acamptochetus Cossmann, 1901, Ess. paléoc. comp. 4 : 123. Type species by OD *Murex mitraeformis* Brocchi, 1814. Mio-Pliocene of Europe.

1943. *Antemetula* Rehder, 1943, Proc. U.S. Nat. Mus. 93 :199. Type species by OD *Buccinum metula* Hinds, 1844. Recent, W. coast of Panama.

Acamptochetus is a typical *Metula* auct. = *Antemetula* Rehder, 1943. Shells are elongate-ovate or fusiformly-elongate, the scupture is generally cancellate but spirals may predominate, the sutures have a smooth or cingulate spiral thread and whorls frequently have flat, adpressed and often obsolete growth-varices. The aperture is narrow and fusiform, the labial lip is finely or obsoletely denticulate, the columella has a smooth and narrow callus and the canal is moderately short.



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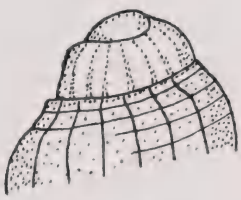

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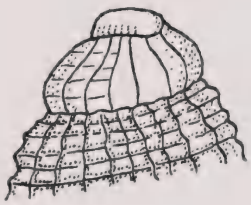

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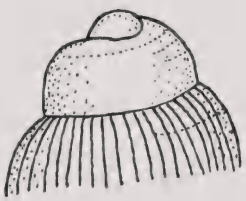

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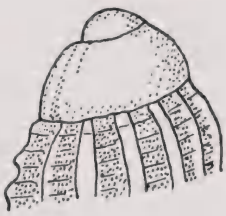

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Figs. 54-58. Protoconchs. 54. *Acamptochetus mitrella* (Adams & Reeve). 55. *Ratifusus adjunctus* Iredale. 56. *R. reticulatus* (A. Adams). 57. *R. (Iredalula) striatus* (Hutton). 58. *Buccinulum lineatum* (Gmelin).

The present author has failed to find a single constant diagnostic character which would allow an easy separation of *Antemetula* from *Acamptochetus*. *A.mitraeformis (Fig. 46)* is a larger species than *A.metula* but the West American *A.amosi* (Vanatta) and the Philippine *A.mitrella* are about the same size as the Mio-Pliocene *A.mitraeformis*. The stratigraphical range of *Acamptochetus* is from the Oligocene to the Recent.

Acamptochetus mitrella (Adams & Reeve, 1850) (Figs. 28,47,54)

1850. *Buccinum mitrella* Adams & Reeve, Zool. Voy. Samarang, p. 32, pl. 11, fig. 13.

1966. *Antemetula mitrella* (Adams & Reeve), Habe & Kosuge, Shells world col. 2:41, pl. 15, fig. 2.

TYPE LOCALITY: China Sea; 10 fathoms (18.3 m).

This species is a typical *Acamptochetus*: the sculpture consists of fine spiral and axial threads, with *c.* 25 spirals on the penultimate and 50 spirals on the body whorl, the sutures are bordered by a fine cingulate thread and the aperture is narrow and fusiform. The labial denticles are small but slightly elongate, and the columella is calloused and smooth. The protoconch has 3 smooth whorls, the teleoconch 6-7 whorls; whorls carry flat, adpressed and sometimes obsolete growth varices which are generally spaced at 80° to 100° intervals, with the exception of the body whorl where generally only the labial varix is present. Similar growth varices are also present in the genus *Ratifusus* Iredale.

The radula (Fig. 28) of *A.mitrella* as figured by Troschel (1867), is very similar to the radula of tropical Pisaniinae. Troschel's radula figure needs of course confirmation.

Genus **Ratifusus** Iredale, 1929

Ratifusus Iredale, 1929, Rec. Aust. Mus. 17(4): 183. Type species by M. *R. adjunctus* Iredale, 1929. Recent, S.E. Australia and New Zealand.

Ratifusus is similar in many features to species of the *Metula-Acamptochetus* group: the sculpture consists of numerous fine spiral threads and axial growth striae, but is more discreet than in either *Metula* or *Acamptochetus*. The protoconch, however, has only 1½ to 2 small and depressed nuclear whorls, the varices are indefinite, flat and adpressed and similar to those in *Acamptochetus mitrella* and *A.mitraeformis;* the radula of *Ratifusus* is appreciably different than the radula of *Acamptochetus*.

Ponder (1968) figured the radulae of *Ratifusus* and *Iredalula,* and showed that the two genera should be re-located in the family Buccinidae, and not that the Colubrariidae are a Buccinacean family. Three large specimens of the type species of *Colubraria,* i.e. *C.maculosa* (Gmelin, 1791) [= *muricata* Lightfoot, 1786] have been examined, and the animal was found to be devoid of a radula. Dr. T. Habe *(in litt.* 2-2-1967), informed the writer that he was also unable to recover a radula from *Colubraria;* it is further significant that no radula of a typical *Colubraria* has been published to date. The absence of a radula in the Colubrariidae indicates that species of the group are edentulous suctorial feeders. The varices in Colubrariidae are thick, swollen and angulate, and placed approxi-

mately at 180° intervals on the whorls, and are appreciably different to the flat, adpressed and often obsolete growth-varices found in several buccinid genera. Similar buccinid growth varices may also be found in certain Thaidine genera, and may also be observed in the Caribbean Miocene buccinid genus *Cymatophos* Pilsbry & Olsson; these varices are clearly visible in illustrations supplied by Jung (1965, pl. 71, figs. 6-8 and pl. 72, figs. 1-2), and Woodring (1964, pl. 41, figs. 3, 5, 8, 13).

The Austral-Neozelanic species *Ratifusus reticulatus* (A. Adams, 1855) (Figs. 51, 56, 60) is not a secondary homonym of *Colubraria reticulata* (Blainville, 1829), and Iredale's substitute name *Fusus mestayerae* Iredale, 1915, is therefore superfluous. *Ratifusus reticulatus,* which belongs in the Buccinidae, was described in the genus *Pisania,* and *Colubraria reticulata,* a member of the Colubrariidae, was described in the genus *Tritonium.*

Dall's (1906) designation of *Murex (Fusus) intertextus* Helbling, 1779 (a prior name for *Colubraria reticulata*) as the type species of *Fusus* Helbling, 1779, presents taxonomic problems. The Mediterranean species *M.(F.) intertextus* Helbling (= *reticulata* Blainville) is unquestionably a *Colubraria,* and as the type species of *Fusus* Helbling, would have priority over *Colubraria* Schumacher, 1817.

In New Zealand, *Ratifusus* dates back to the Upper Eocene (Maxwell,1966). The species *Colubraria neozelanica* Maxwell, 1966, from McCullough's Bridge, (Kaiatan), U.Eocene of New Zealand, is a *Ratifusus* and not a *Colubraria.*

Genus **Iredalula** Finlay, 1926

Iredalula Finlay, 1926, Trans. Proc. N.Z. Inst. 56 : 231. Type species by OD *Bela striata* Hutton, 1873. Pleistocene and Recent, New Zealand.

Ponder (1968) acknowledged the close relationship of *Ratifusus* and *Iredalula* in features of anatomy, shell form, sculpture and protoconch, but pointed out differences in the lack of varices and labial denticles in *Iredalula.* Several specimens of *I.striata* (Hutton) were examined, and 4 flat varices were observed in a specimen from the Bay of Plenty, 5 varices in a specimen from Cuvier Island and 1 varix in a specimen from the Hauraki Gulf. In *I.alticincta* (Murdoch & Suter) the varices were found to be obsolete, and took on the form of overlapping axial lines which may resemble repair marks; similar indistinct varices or rest-period marks have also been observed in some specimens of the South African *Afrocominella elongata* (Dunker).

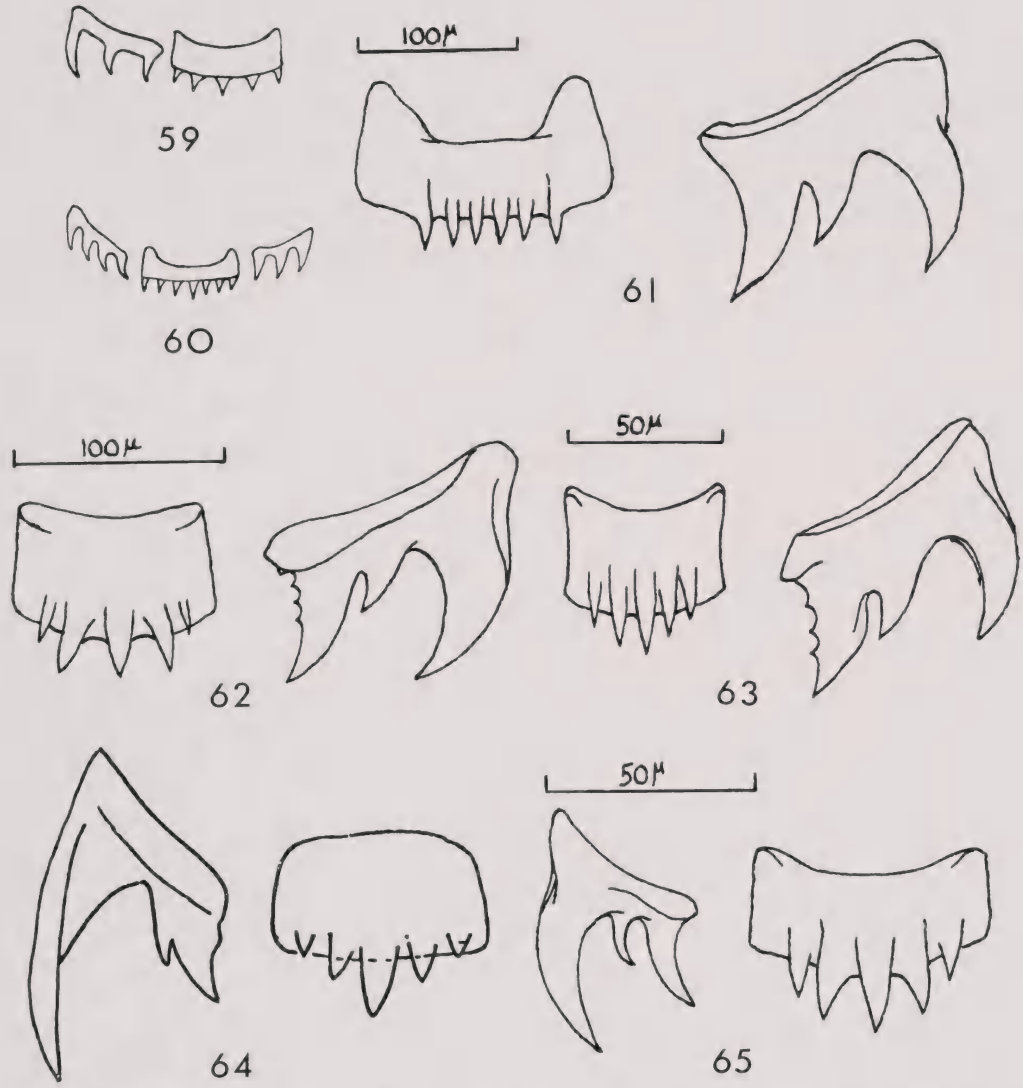
In *Ratifusus adjunctus* the labial lip is either smooth (described as "quite smooth inside" by Iredale, 1929), or finely serrated, whereas in *Iredalula striata* the labial lip is generally smooth; in some specimens of *I.alticincta,* however, the labial lip is bluntly denticulate and the aperture lirate within. It is therefore diffcult to perceive on what basis *Ratifusus* and *Iredalula* are generically separable, when diagnostic features of one group are also represented in the other.

Kanamarua Kuroda, 1951 (type species *Colus (Aulacofusus) adonis* Dall from Japan) should also be located in the *Metula-Ratifusus* group; the type species resembles *Ratifusus* more than it does *Metula* or *Acamptochetus.*

Genus **Cantharus** Röding, 1798

Cantharus Röding, 1798, Mus. Bolten., p. 132. Type species by SD (Cossmann, 1901). *Buccinum tranquebaricum* Gmelin, 1791. Recent, Indian Ocean.

1807. *Nassaria* Link, Beschr. Nat.-Samml. Univ. Rostock 3 Abth., p. 123. Type species by SD (Dell, 1967) *N.tranquebarica* Link = *Buccinum tranquebaricum* Gmelin, 1791.



Figs. 59-65. Radulae. 59. *Ratifusus (Iredalula) striatus* (Hutton). Between Cape Runaway and Ohiwa Harbour, New Zealand (from Ponder, 1968, fig. 9). 60. *R. reticulatus* (A. Adams). Bay of Islands, New Zealand (from Ponder, 1968, fig. 7 — as *R. mestayerae* Iredale). 61. *Japeuthria ferrea* (Reeve). Minoshima, Wakayama, Japan. 62. *Cantharus (Pollia) undosus* (Linnaeus). Nadroga reef, Korotogo, Fiji I. 63. *C. (P.) subrubiginosus* (E. A. Smith). Nananu-i-Ra I., Fiji I. 64. *Engina turbinella* (Kiener). Buccoo reef, Tobago I., B.W.I. (from Orr, 1962, textfig.). 65. *E. alveolata* (Kiener). Viti Levu Bay, Fiji I.

1834. *Pusio* Griffith & Pidgeon, Anim. Kingd. Moll. Rad. Cuvier 12: pl. 25, fig. 2. Type species by SD (Gray, 1847) *P.elegans* = *Triton (Pusio) elegans* Griffith & Pidgeon,, 1834. Recent, W. coast America.

1953. *Gemophos* Olsson & Harbison, Acad. Nat. Sci. Philad. Mon. No. 8 : 225. Type species by OD *Buccinum gemmatum* Reeve, 1846. Recent, W. Coast America.

Subgenus **Pollia** Gray in Sowerby, 1834

Pollia Gray in Sowerby, 1834, Gen. Rec. Foss. shells 2 : footnote to Purpura, pl. 237, fig. 12. Type species by M *Triton undosus* Lamarck = *Buccinum undosum* Linnaeus, 1758. Recent, Indo-Pacific.

1840. *Tritonidea* Swainson, Treat. Malac., p. 302. Type species by SD (Gray, 1847) *T.undosa* = *Buccinum undosum* Linnaeus, 1758).

It is somewhat problematical whether *Cantharus, Pollia, Hanetia* and *Engina* should be placed in either the subfamily Pisaniinae or Photinae, or in a separate subfamily Cantharinae as Iredale intended (1940) through his proposition of Pusiostomatidae. Iredale's family-group is not applicable to the Buccinidae as the type genus *Pusiostoma* Swainson, belongs in the Columbellidae.

Species of *Pollia* differ from *Cantharus* in having convex whorls which are not angulate on the presutural ramp. The radula of the type species of *Cantharus* remains unknown, but the radulae of tropical *Pollia* are basically similar to the radula of *Pisania striata,* except that the inward facing edge of the inner cusp of the lateral is always serrated. Robertson (1957), figured radulae of American *Cantharus* species which are even more similar to the radula of *Pisania striata* in that they lack the serrations of the inner cusp.

Species of *Engina* are easily separated from the *Cantharus-Pollia* group of species: in *Engina* the entire columella is calloused and the columella denticles reach as high as the parietal wall; the interior of the columella is projecting, with the projection occasionally bifurcate as in Columbellidae. In *Cantharus,* the columellar callus becomes thin in the centre of the columella, where only the body whorl sculpture is visible; the bifurcate columella projection is also lacking.

Cantharus (Pollia) undosus (Linnaeus, 1758) (Figs. 36,62,66)

1758. *Buccinum undosum* Linnaeus, Syst. Nat. ed. 10, p. 740.

1791. *Buccinum affine* Gmelin, Syst. Nat. ed. 13, p. 3490.

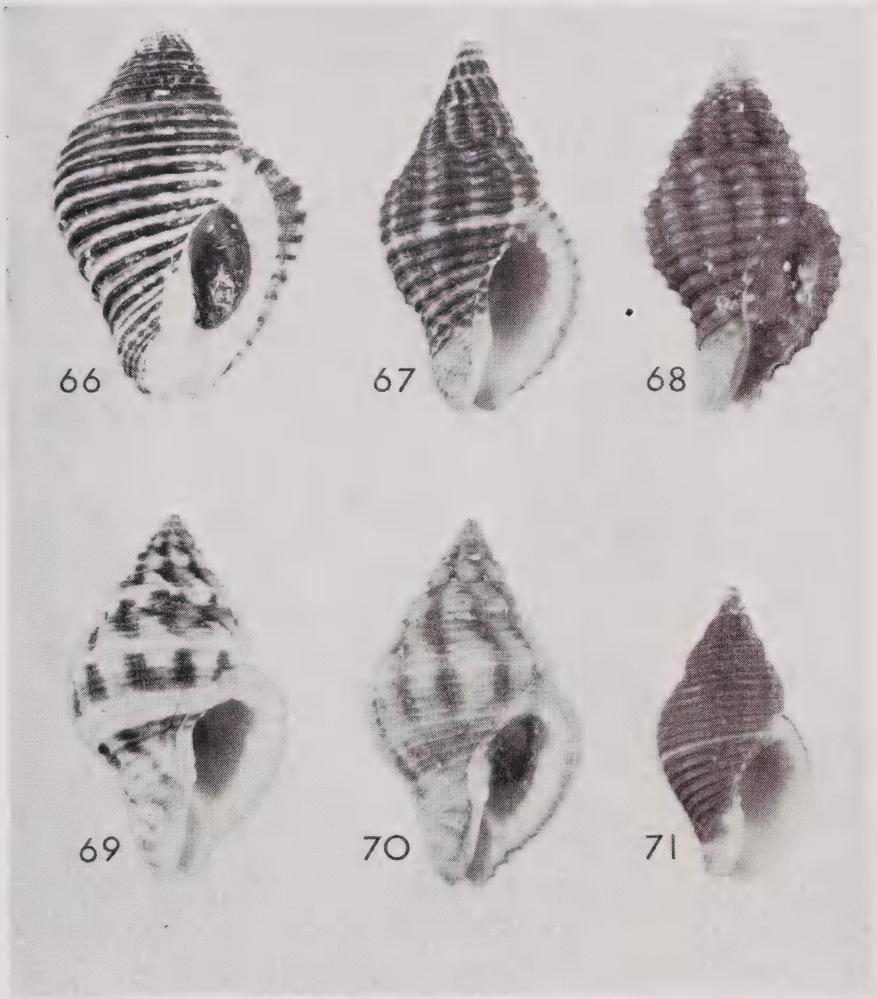
TYPE LOCALITY: Asia.

In large specimens of *C.undosus* the shell is strongly spirally corded, without axial ribs, and the labial lip is angulate posteriorly. Small specimens of *C.undosus* are frequently axially costate all the way to the body whorl, and the labial lip is regularly convex; these specimens can be separated from *C.fumosus* only with difficulty. The radula (Fig. 62) has laterals with a serrated inner cusp.

Cantharus (Pollia) fumosus (Dillwyn, 1817) (Fig. 67)

1817. *Buccinum fumosum* Dillwyn, Descr. cat. shells 2 : 629 (ref. Chemnitz, Vol. 4, pl. 123, upp. figs. 1145-46).

1846. *?Buccinum rubiginosum* Reeve, Conch. Icon. 3 : pl. 7, fig. 47 (Red Sea).



Figs. 66-71. Shells. 66. *Cantharus (Pollia) undosus* (Linnaeus). Korotogo, Fiji I., intertidal; length 32.8mm. 67. *C. (P.) fumosus* (Dillwyn). Manava I., Fiji I., intertidal; length 22.8mm. 68. *C. (P.) pulcher* (Reeve). Manava I., Fiji I., intertidal; length 19.8mm. 69, 70. *C. (P.) wagneri* (Anton). Malolo Barrier reef, Mamanuca group, Fiji I., intertidal. 69. Length 28.0mm (without periostracum). 70. Length 22.8mm (with periostracum). 71. *C. (P.) subrubiginosus* (E. A. Smith). Nananu-i-Ra I., Fiji I., intertidal; length 15.8mm.

1846. *Buccinum proteus* Reeve, Conch. Icon. 3: pl. 7, fig. 51 (Ceylon, Philippines & Australia).

TYPE LOCALITY: None.

The species is similar to *C.undosus,* except that the axial ribs are well developed on later whorls; the interstices of the spiral cords are axially striated in both species. It is suspected that *C.fumosus* is only an individual or developmental form of *C.undosus.*

Cantharus (Pollia) wagneri (Anton, 1839) (Fig. 69-70)

1829. *Turbinella craticulata* var. B. Schubert & Wagner, Syst. Conch. Cab. 12 :103, pl. 227, figs. 4023-24 (non *Murex craticulatus* Linnaeus, 1758).

1839. *Turbinella wagneri* Anton, Verz. Conchyl., p. 71 (nom. nov. pro. *Turbinella craticulata* var. b. Schubert & Wagner, 1829).

1847. *Turbinella crenulata* Reeve, Conch. Icon. 4 : pl. 4, sp. 24 (non Kiener, 1840).

TYPE LOCALITY: None. (Isle of Capul, Philippines — Reeve, 1847).

The species is creamy-white to yellowish in colour, the spiral cords are orange-brown and the body whorl has 3 spiral rows of purple spots which are situated in the interstices of the axial ribs. The operculum is yellowish-brown, with a basal nucleus; the periostracum is brown and opaque.

Cantharus (Pollia) pulcher (Reeve, 1846) (Fig. 38,68)

1846. *Ricinula pulchra* Reeve, Conch. Icon. 3 : pl. 3, figs. 20 a,b (August 1846).

1879. *?Peristernia elegans* var. *papuensis* Tapparone-Canefri, J. Conchyl. 27 :325 (Port Dorey, New Guinea).

1959. *Engina purchra (sic)* (Reeve), Kira, Col. Illust. shells Japan 1 : 66, pl. 26, fig. 3.

TYPE LOCALITY: Island of Capul, Philippines.

The species is reddish-brown and shining, the intersticial spiral grooves are dark brown, the siphonal canal, nuclear whorls and aperture are rosy-pink in colour, the siphonal canal is produced and the axial ribs are close-set.

Habe & Kosuge (1967) located the species in *Engina,* but the species lacks the calloused columella, denticles along its entire length and the projecting interior of the columella. Tapparone-Canefri (1879) synonymized *Cantharus pulcher* with *Turbinella elegans* Dunker in Küster, but the description and figure of the latter associate the species with *Engina incarnata* (Deshayes in Laborde & Linant).

Cantharus pulcher (Reeve) may have at times been confused with the West American *Engina pulchra* (described as *Buccinum pulchrum* Reeve — December 1846), which is a typical *Engina* and not a *Cantharus.*

Cantharus (Pollia) subrubiginosus (E. A. Smith, 1879) (Figs. 37,63,71)

1879. *Tritonidea subrubiginosa* E. A. Smith, Proc. Zool. Soc. Lond., p. 206, pl. 20, fig. 40.

TYPE LOCALITY: Ukushima, Goto Islands, Japan; among rocks at low water.

The species is small, 10-17 mm in length, nuclear whorls are smooth, light brown, with the initial turn white; the shell is uniformly dark reddish-brown in colour with a narrow, white central band on the body whorl. The spiral cords are regular, thin and elevated, interspaces are broader than the threads and sculptured with fine intersticial spiral lirae and obsolete axial growth striae. The early whorls are axially ribbed, the last two whorls are smooth or obsoletely costate. The aperture is bluish-white, the labial lip has 12 elongated denticles which continue as lirae into the aperture, the anterior of the columella is white and has 1-3 small denticles; the centre of the columella is brownish, the parietal wall is calloused and

has a small denticle. The radula (Fig. 63) has laterals with a serrated inner cusp; the periostracum is brown and moderately translucent.

Fijian specimens of *Cantharus subrubiginosus* agree with the original description in every detail. Specimens of *C.natalensis* (E.A.Smith,1901) from South Africa examined, were found to be very similar to the Fijian examples of *C.subrubiginosus*. In the Fiji Islands, *C.subrubiginosus* lives among coarse weed on the underside of coral rocks in the intertidal zone.

Genus **Engina** Gray, 1839)

Engina Gray, 1839, Zool. Capt. Beechey's Voy. Blossom, p. 112. Type species by SD (Gray, 1847) *Enzina zonata* Gray, 1839 = *Purpura turbinella* Kiener, 1836. Recent, Caribbean.

1847. *Enzina* Gray, Proc. Zool. Soc. Lond., p. 133 (nom. null.).

1940. *Enzinopsis* Iredale, Aust. Zool. 9 :434. Type species by OD *E.gannita* Hedley = *Engina gannita* Hedley, 1915. Recent, Torres Straits.

Species of *Engina* are superficially similar to *Cantharus* and *Pollia*, but the aperture is narrower, the siphonal canal shorter, the columella is calloused and denticulate along its entire length and the interior of the columella is projecting and often bifurcate.

The radula (Figs. 64-65) has pentacuspid rachidians, and the laterals are either bicuspid or tricuspid; the outer cusp of the laterals is very long and slender. Tropical *Engina* live either under basal rocks at the high tide level or under coral rocks of the intertidal zone.

Engina alveolata (Kiener, 1836) (Figs. 39,65,76-77)

1836. *Purpura alveolata* Kiener, Spéc. gén. icon. coq. viv., p. 42, pl. 9, fig. 23. (Hab :?).

1846. *Ricinula lauta* Reeve, Conch. Icon. 3 : pl. 4, fig. 24 (Hab :?).

1846. *Ricinula histrio* Reeve, Conch. Icon. 3 :pl. 5, fig. 36.

1865. *Engina fusiformis* Pease, Proc. Zool. Soc. Lond. p. 513 (Central Pacific).

1868. *Engina fusiformis* Pease, Amer. J. Conch. 3 : 273, pl. 23, fig. 5 (Howland I.).

1965. *Engina fusiformis* Pease, Kay, Bull. Brit. Mus. (Nat. Hist.), Zool. Suppl. 1 : 81, pl. 13, figs. 15, 16 (figd. lectotype).

TYPE LOCALITY: *None*. (Island of Ticao, Philippines — for *histrio* Reeve).

The shell is white in colour, ornamented with double rows of black nodules and intermediate rows of reddish-orange nodules; the columella is reddish-brown, denticulate, and lirate on the parietal wall. The operculum is small, translucent yellowish-brown with a dark brown central zone and a basal nucleus. The radula (Fig. 65) has pentacuspid rachidians and tricuspid laterals.

The reddish-orange nodules are occasionally missing in some individuals, and it is this form on which *Purpura alveolata* was based. The species is rather common throughout the Pacific; specimens will reach 25.0 mm in length.

Engina zonalis (Lamarck, 1822) (Figs. 72-75)

1817. *?Voluta nana* Dillwyn, Descr. Cat. rec. shells 1536 (ref. Martini, Vol. 2, pl. 44, fig. 459) [Mediterranean.].

1822. *Colombella zonalis* Lamarck, Hist. nat. anim. s. vert. 7:297 (Hab:?).

1846. *Ricinula zonata* Reeve, Conch. Icon. 3: pl. 5, sp. 33 (non *Engina zonata* Gray, 1839) [Charles I., Galapagos Islds. — error!].

1928. *Engina melanozona* Tomlin, Nautilus 42 (2): 40 (*nom. subst. pro Ricinula zonata* Reeve, 1846).

1938. *Engina zonata* Reeve, Adam & Leloup, Mem. Mus. Roy. Hist. Nat. Belg. 2(19): 178, pl. 8, fig. 2 (non Gray, 1839).

1967. *Engina melanozona* Tomlin, Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119 (4), 135, pl. 12, fig. E.

TYPE LOCALITY: None. (New Caledonia, Tomlin, 1928).

The species is white, the spiral zones are black and may be interrupted by white nodules; the aperture is mauve or dark reddish-brown, and the siphonal canal has short wavy lines.

The figure from Martini (1773) cited for *Voluta nana* Dillwyn, is a miniature reproduction of a species which could possibly be identical with *Engina zonalis*. Martini (loc.cit.) described the species as being banded with black and white and reported its occurrence in the Mediterranean; the short description and erroneous locality raise some doubt about the species identity, which could be either *E.zonalis* or *E.lineata* Reeve.

Lamarck's holotype of *Colombella zonalis* is in the Muséum d'Histoire Naturelle, Geneva, No. 1102/40: length 9.6 mm; another 5 paratypes are in the same collection. Lamarck's types of *C.zonalis* are the same species as *Ricinula zonata* Reeve and *Engina melanozona* Tomlin.

Engina lineata (Reeve, 1846) (Fig. 78)

1846. *Ricinula lineata* Reeve, Conch. Icon. 3: pl. 6, fig. 51.

1869. *Ricinula lineata. var. maculata* Pease, Amer. J. Conch. 5: 76, pl. 8, fig. 12 (Apaian I. = Abaiang I., Gilbert Islds.).

1962. *Engina lineata* (Reeve), Habe, Col. Illust. shells Japan 2: 61, pl. 31, fig. 1.

TYPE LOCALITY: Island of Ticao, Philippines.

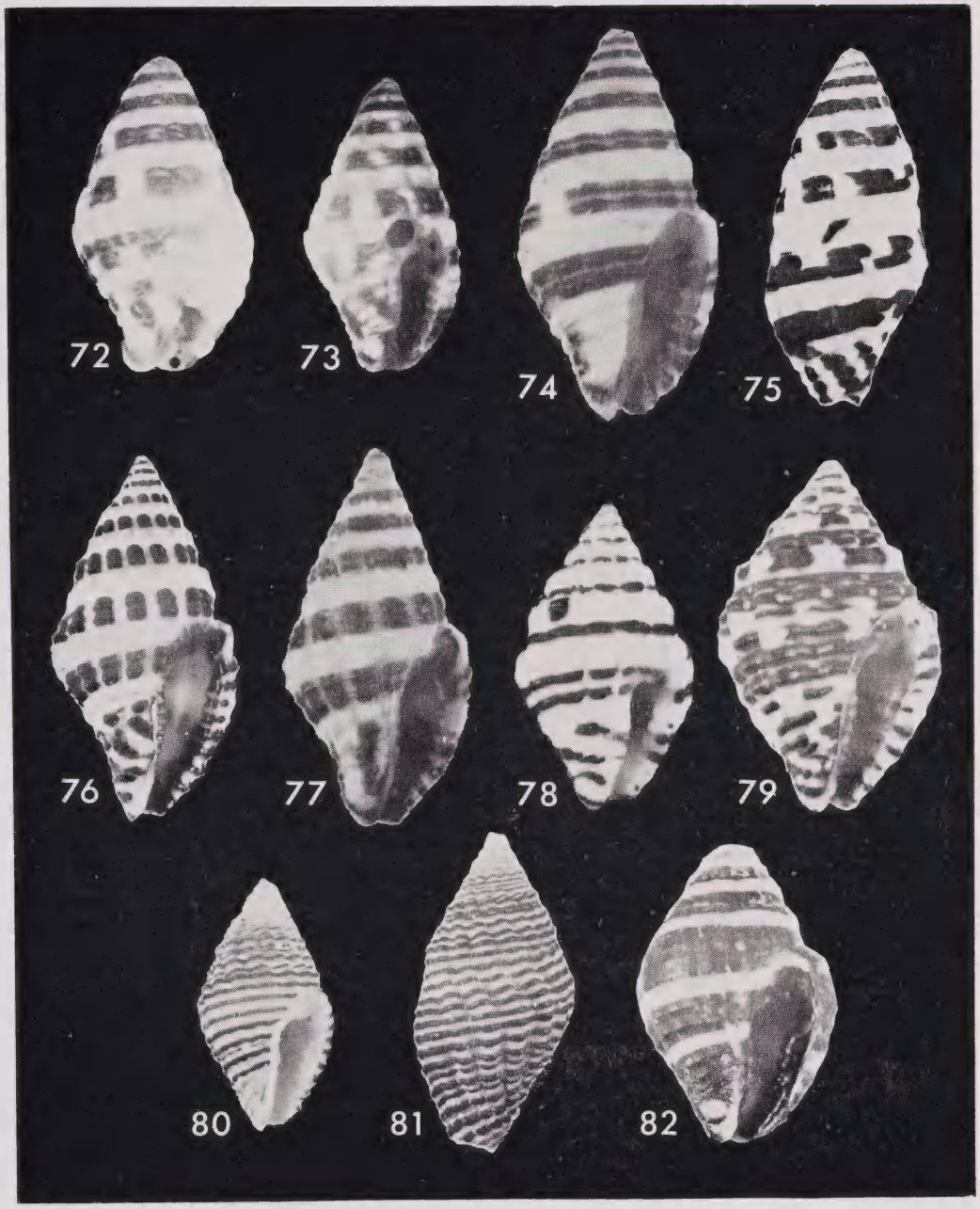
The species is superficially similar to *Engina zonalis* Lamarck, but is slightly smaller, *c*.8.0-10.0 cm in length, the blackish spiral zones are narrow, continuous lines, and at the sutures are wide-spaced, round or crescent-shaped black spots. The aperture is white and not purplish-brown as in *E.zonalis*. In the Fiji Islands, *E. lineata* is collected more frequently than *E.zonalis*.

Engina phasinola (Duclos, 1840) (Fig. 79)

1840. *Columbella phasinola* Duclos, Hist. nat. coq. univ., pl. 8, figs. 13-16.

TYPE LOCALITY: None.

Shell moderately small, 12-16 mm in length, solid; live-taken specimens black in colour, ornamented with irregular, scattered white spots. Sculptured with nodulose spiral cords, aperture very narrow, purplish-brown in colour, labial and columellar lips prominently denticulate.



Figs. 72-82. Shells. 72-75. *Engina zonalis* (Lamarck). 72. Syntype Mus. Hist. Nat. Geneva No. 1102/40; length 10.3mm. 73. Lectotype Mus. Hist. Nat. Geneva No. 1102/40; length 9.6mm. 74. Viti Levu Bay, Fiji I., intertidal; length 13.0mm. 75. Viti Levu Bay, Fiji I., intertidal; length 20.6mm (slender form). 76, 77. *E. alveolata* (Kiener). Viti Levu Bay, Fiji I., intertidal. 76. Length 21.8mm. 77. Length 12.8mm (variant without red spots). 78. *E. lineata* (Reeve). Manava I., Fiji I., intertidal; length 10.4mm. 79. *E. phasinola* (Duclos). Manava I., Fiji I., intertidal; length 12.3mm. 80-81. *E. incarnata* (Deshayes in Laborde & Linant). Manava I., Fiji I., intertidal. 80. Length 14.0mm. 81. Length 18.0mm. 82. *E. mendicaria* (Linnaeus). Viti Levu Bay, Fiji I., intertidal; length 16.6mm.

The species is uncommon throughout the Pacific region.

Engina mendicaria (Linnaeus, 1758) (Fig. 82)

1758. *Voluta mendicaria* Linnaeus, Syst. Nat., ed. 10, p. 731.

1962. *Pusiostoma mendicaria* (Linné), Kira, Col. Illust. shells Japan, rev. ed. 1:66, pl. 26, fig. 1.

TYPE LOCALITY: Asia.

In comparison with other Pacific *Engina* species, *E.mendicaria* is rather smooth, with only the early whorls axially costate; the species is purplish-black in colour, ornamented with yellow or white transverse zones of varying width. The columella differs from other *Engina* species in being smooth, apart from 1 to 2 anterior denticles. Specimens are commonly found under basalt rocks at the high tide level.

Engina incarnata (Deshayes in Laborde & Linant, 1834) (Figs. 80-81)

1834. *Peristernia incarnata* Deshayes in Laborde & Linant, Voy. L'Arabie & Pétrée, figs. 20,21.

1844. ?*Turbinella elegans* Dunker in Küster, Syst. Conch. Cab., ed. 2,3,(3A) : 33, pl. 7, fig. 4 (Hab : ?) [non *Engina elegans* Gray, 1839].

1846. *Ricinula astricta* Reeve, Conch. Icon. 3 :pl. 4, sp. 30 (Hab : ?).

1879. *Peristernia paulucciae* Tapparone-Canefri, J. Conchyl. 27 : 325 (Mauritius).

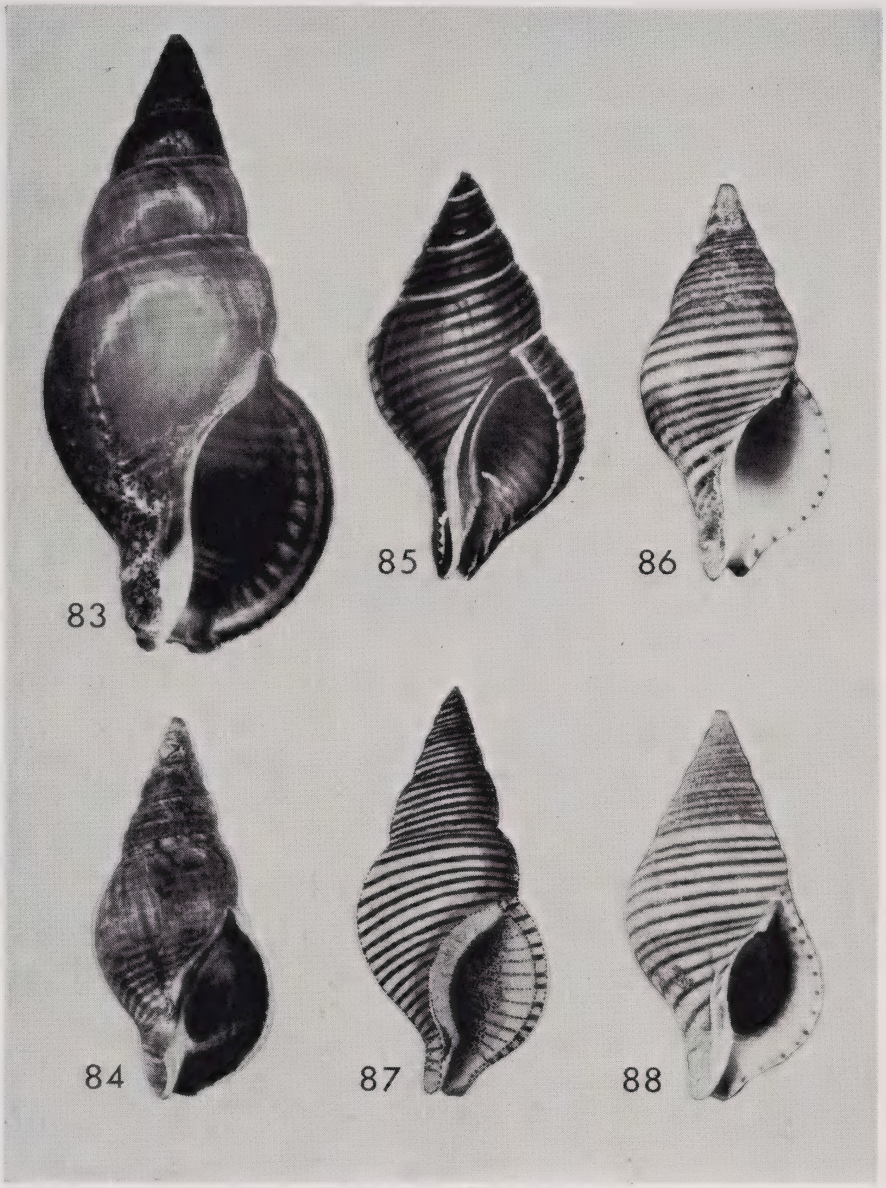
1880. *Peristernia kobeltiana* Tapparone-Canefri, Ann. Soc. Malac. Belg. 15(1) : 71, pl. 2, figs. 14,15 *(spec. juv)* [non *P.kobeltiana* Tapparone-Canefri, 1879].

TYPE LOCALITY: Red Sea.

Shell moderately small, 13-20 cm in length, dirty-white or creamy-yellow in colour, spiral cords dark reddish-brown. Sculptured with close-set, rounded axial ribs and elevated reddish-brown spiral cords; interstices of spiral cords macroscopically axially striate and sometimes contain 1 or 2 very fine spiral threads. Aperture narrow, creamy-white with a slight pink hue, labial lip with 7-8 distinct denticles; columella calloused along entire length, denticulate, and lirate on parietal wall; siphonal canal short and straight.

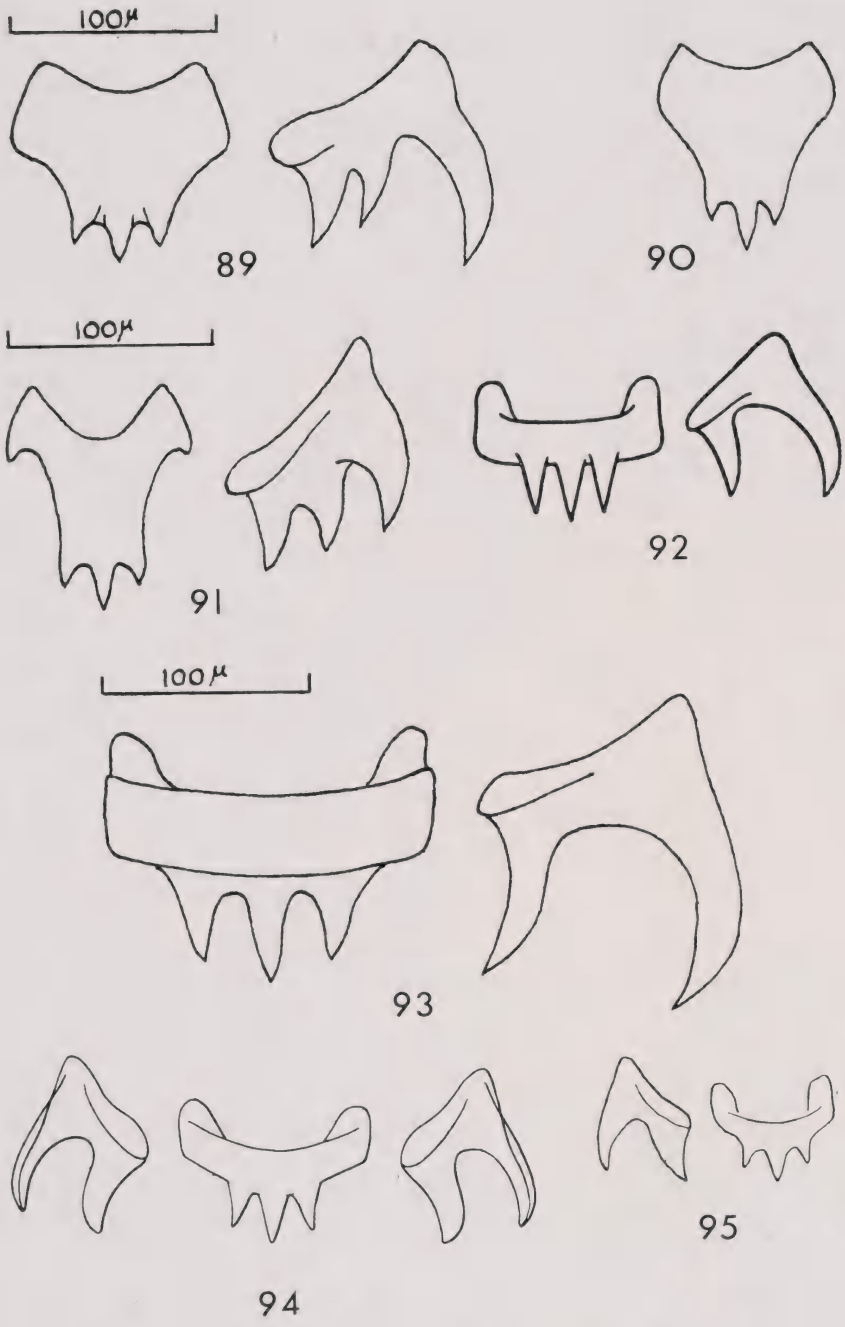
The species has been confused with a superficially similar *Peristernia* species. Kiener (1840 pl. 18, fig. 3) initiated the confusion by illustrating a different fasciolarid species under the name *Turbinella incarnata* Deshayes. Kiener's species has also been illustrated by Habe (1962, pl. 33, fig. 8) as *Peristernia incarnata;* this particular fasciolarid species has yellowish-brown, smooth axial ribs, the axial interstices are dark brown, the intersticial spiral threads are short and lammelate, the aperture is violet or rose-purple, the columella is smooth apart from a few anterior denticles and the siphonal canal is produced.

Deshayes' (1834) figures of *Engina incarnata* agree with Fiji specimens here illustrated in all essential details. The description of *Turbinella elegans* Dunker in Küster (1844, loc. cit.) is reminiscent of *Engina incarnata,* but the accompanying figure raises some doubt whether the two species are identical. In his description of *Peristernia paulucciae,* Tapparone-Canefri (1879) provided a fairly good diagnosis of the species, and his later illustration leaves no doubt that the figured species, although possibly somewhat faded, is the same species as *Engina incarnata.*



Figs 83-88. Shells. 83, 84. *Japeuthria ferrea* (Reeve). 83. Syntype of *Buccinum ferreum* Reeve. B.M.N.H.; length 32.6mm. 84. Minoshima, Wakayama, Japan; length 31.3mm. 85, 86. *Buccinulum linea* (Martyn). 85. Type figure of *Buccinum linea* Martyn (from Martyn. 1784, pl. 48, lower figure). 86. Milford, Auckland, New Zealand, intertidal; length 40.8mm. 87, 88. *Buccinulum lineatum* (Gmelin). 87. Type figure of *Murex lineatus* Gmelin (from Chemnitz, 1788, pl. 164, fig. 1572). 88. Worser Bay, Wellington Harbour, New Zealand; length 37.0mm.

Tapparone-Canefri (1879) proposed the substitute name *Peristernia kobeltiana* for *Turbinella zealandica* Kobelt, 1876, a species which is a *Latirus*. The figure of *Peristernia kobeltiana* Tapparone-Canefri,1880, from Mauritius, (Tapparone-Canefri 1880, pl. 3, figs. 17,18) is an immature specimen of *Engina incarnata*.



Figs. 89-95. Radulae. 89, 90. *Buccinulum lineatum* (Gmelin). 89. Manukau Harbour, Auckland, New Zealand, intertidal. 90. Rachidian of radula of specimen from the same locality. 91. *B. linea* (Martyn). Pt. Chevalier, Auckland, New Zealand, intertidal. 92. *Cominella maculosa* (Martyn). Motuihe I., Hauraki Gulf, New Zealand (from Powell, 1929, fig. 127). 93. *C. virgata* (H. & A. Adams). Wellington Bay, New Zealand. 94. *Phos senticosus* (Linnaeus). Philippines (from Troschel, 1867, pl. 8, fig. 1). 95. *Northia northiae* (Griffith & Pidgeon). West coast of America (from Cooke, 1917, textfig.).

Engina incarnata has an Indo-Pacific distribution, and has been recorded as far East as the Tonga Islands (leg. H. C. Gay). In the Fiji Islands the species is rare.

Subfamily BUCCINULINAE Finlay, 1928

1928. Buccinulidae Finlay Trans. Proc. N.Z. Inst. 59:250.

The subfamily contains recent temperate water buccinids from the Mediterranean, South African and Austral-Neozelanic regions; some fossil species from Tertiary deposits of Indonesia may also be referable to this subfamily. Shells are moderate in size, the canal is slender and somewhat produced, the labial lip is either weakly denticulate, serrated or sculptured with elongated denticles; the columella is denticulate only anteriorly or along its entire length, and the parietal wall has a single denticle in adult specimens. The radula of species of *Buccinulum, Euthria* and *Afrocominella* is similar to the radula of *Pisania;* the rachidians and laterals are both tricuspid. The genus *Burnupena* from South Africa and *Japeuthria* from Japan, would probably be more correctly located in the Buccininae instead of the Buccinulinae. The radula of *Japeuthria ferrea* (Reeve), (Fig. 61 radula, Figs. 83, 84 shell), the type species of *Japeuthria* Iredale, has rachidians which are similar to those of *Burnupena* and *Buccinum.*

Genus **Buccinulum** Deshayes, 1830

Buccinulum Deshayes, 1830, Encycl. Méth. vers, ed. 2, 2 (1): 143. Type species by SD (Iredale, 1921 — art. 69(a) (ii) ex-Swainson, 1837) *Murex lineatus* Gmelin, 1791. Recent, New Zealand.

1853. *Evarne* H. & A. Adams, Gen. Rec. Moll. 1:79. Type species by M *Fusus (Evarne) linea* Mart. = *Buccinum linea* Martyn, 1784. *(Nom. conserv).*

Buccinulum lineatum (Gmelin,1791) (Figs. 87-90)

1788. "*Murex lineatus* Chemnitz", Syst. Conch. Cab. 10:278, pl. 164, fig. 1572 (New Zealand) [*non binom.*].

1791. *Murex lineatus* Gmelin, Syst. Nat., ed. 13, p. 3559 (ref. Chemnitz, op. cit. fig. 1572).

1929. *Buccinulum (Evarnula) multilineum* Powell, Trans. Proc. N.Z. Inst. 60:78, pl. 1, figs. 17,18 & textfig. 90).

TYPE LOCALITY: New Zealand.

The type species of *Buccinulum,* i.e. *B.lineatum* (Gmelin), is not the same species as *B.linea* (Martyn) (Fig. 86), but is conspecific with the species currently known in malacological literature as *B.multilineum* Powell.

Apart from prominent differences in the radulae (Figs. 89-91) and egg-capsules, morphological differences in the shells of *B.linea* and *B.lineatum* are subtle indeed. The only single, constant differentiating character of the two species is the outline of the sinistral side of the body whorl when viewed ventrally. In *B.linea* the central point of the concave constriction passes through the lower third of the columella, whereas in *B.lineatum* the centre of the constriction is lower, i.e. near the commencement of the siphonal canal. The siphonal canal in *B.linea* appears longer and straighter, but shorter and somewhat recurved in *B.lineatum.*

Martyn's (1784) figure of *Buccinum linea* (Fig. 85) shows the *Buccinulum linea* of authors; the canal is elongated and straight and the centre of the constriction is positioned well above the start of the siphonal canal. The figure of *B.lineatum* from Chemnitz (1788) is an unmistakable illustration of the species *B.multilineum* Powell (Figs. 87-88).

Subfamily PHOTINAE Troschel, 1867

1867. Photina Troschel, Geb. Schnecken 2(2) : 82.

1881. Photinae Tryon, Man. Conch. 3 :98.

1901. Cominellinae Cossman, Ess. paléoc. comp. 4 :137.

1913. Cominellinae Suter, Man. N.Z. Moll., p. 391.

The subfamily contains species with a very short or only slightly produced and notched siphonal canal, a labial lip without denticles and a striate or lirate labrum; species of some Miocene genera have distinct growth-varices. The radula of Photinae (Fig. 94-95) consists of tricuspid rachidians with loop-like basal extensions and laterals which are bicuspid.

Powell (1929) assigned the genera *Cominella, Fax, Phos, Pareuthria* and *Searlesia* to the Cominellidae. *Northia* Gray and several Caribbean Miocene *Phos*-like and *Cominella*-like genera *(e.g. Calophos ectyphus* Woodring, 1964), are also referable to this subfamily. The subfamilial name Photinae has chronological priority over Cominellinae, and no evidence has been advanced to date which would necessitate a familial separation of the Photinae from the Buccinidae.

Genus **Phos** Montfort, 1810

Phos Montfort, 1810, Conchyl.Syst. 2:495. Type species by OD *Phos senticosus* = *Murex senticosus* Linnaeus, 1758. Recent, Indo-Pacific.

1840. *Rhinodomus* Swainson, Treat. Malac., p. 305. Type species by M. *R.senticosus* Chemnitz = *Murex senticosus* Linnaeus, 1758.

The subfamily is represented in the Fiji Islands by the widely distributed, tropical species *Phos senticosus* (Linnaeus).

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THE FAMILY NATICIDAE (MOLLUSCA: GASTROPODA) IN THE FIJI ISLANDS

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Abstract. The family Naticidae is represented in the Fiji Islands by 21 Recent species which are assignable to 3 genera and 3 subgenera. In addition, Ladd (1934) recorded Recent species of Polinicinae from Tertiary deposits of Viti Levu, and Ladd & Hoffmeister (1945) described species of Globulariinae from Tertiary deposits of the Lau Islands. Species of the latter subfamily have become extinct in Fiji. All the Recent species recorded from the Fiji Islands have a wide Indo-Pacific distribution and no endemics have been recognized.

The family Naticidae is world-wide in distribution and species are found in tropical and temperate waters. Tropical Naticidae live chiefly within the intertidal region and dredging in Fiji at depths of 15-20 fathoms (27-37 metres) failed to add any new records to the intertidal naticid population. Species in the family are moderately numerous, but the actual number of species recorded from the Fiji Islands is comparatively small. A certain number of named variants of doubtful taxonomic value is to be anticipated in view of the usual degree of ecophenotypic and individual variation evident in populations of Naticidae.

TAXONOMY

A natural supraspecific classification of the Naticidae, based on some tangible evidence of genetic or phylogenetic affinities, remains to be proposed for Recent and fossil groups. Modern writers generally interpret genetic affinities on the basis of opercula and the arrangement of the funicle within the umbilicus. Palaeontologists, who rarely obtain specimens accompanied by opercula, rely solely on umbilical features in deciding the species' generic relationship. Malacologists derive no advantage from anatomical examinations in achieving a more natural and correct classification. Risbec (1956) who examined the anatomy of tropical Naticidae did not hesitate to combine *Polinices* and *Natica* in a single genus, despite the differences in opercula of the two groups. *Polinices* and *Natica* are placed in two separate subfamilies on the basis of corneous and calcareous opercula; on the basis of the radula, however, both genus-groups would be regarded as congeneric. The genera *Natica* s.str. and *Tanea* on the other hand, have a prominent different type of radula, but both genera are currently included in the same subfamily. This clearly illustrates the artificiality of our present naticid classification. A more natural classification, probably too orthodox in a modern taxonomic concept, would be to consider species which differ only in the type of operculum but not the radula, to be only subgenerically separable from each other; species such as *Tanea* or *Globisinum* which show distinct differences in radular pattern, should be separated generically.

The importance placed on the form and sculpture of the operculum in naticid classification is overrated in the writer's opinion. Early forerunners of Naticidae

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most probably had a single type of operculum, i.e. a calcareous one. This prototypic operculum was aborted in the naticid, cul-de-sac offshoot group of Polinicinae but was retained by species of Naticinae. The presence of an inner corneous operculum, which on one side is attached to the animal's foot and on the other to the outer calcareous operculum, would tend to lend some support to this hypothesis. In naticid specimens which have been preserved in alcohol and which have hardened after removal, the calcareous operculum is easily dislodged or may even fall off from its corneous opercular backing; this may account for literature reports of true naticids having a corneous operculum.

In tropical Naticidae, the radula is of little taxonomic value in separating species, genera or subfamilies, and the radulae of *Polinices* and *Natica* are practically the same. The protoconch is even less reliable in tropical naticids and is more or less of a sterotyped form. Several writers have expressed doubt as to the stability of funicular characters, particularly the size of the funicle and the direction of entrance into the umbilicus. The funicle of *Natica gualtieriana* Récluz (= *marochiensis* auctt.) is variable indeed, sometimes small, leaving a wide umbilical space and at other times fairly broad and almost filling the umbilicus. Being a common species, the variability of the funicle in *N.gualtieriana* is easily observed, and is no more excessive than in species of which large series are unobtainable.

Species of Naticidae have either a corneous or calcareous external operculum, and each type is confined to a particular species. In unisulcate calcareous opercula, the arrangement of the marginal rib shows a certain amount of variation: there may be a marginal groove, followed by an elevated rib which is bordered once again by a groove, or a marginal rib which is followed by a groove, or only a marginal rib without any grooves whatsoever. In Fijian populations of Naticidae, species with a unisulcate operculum never produce an aberrant with a multisulcate operculum and vice versa. In *Natica vitellus* (Linnaeus), however, the operculum is either bisulcate or trisulcate. The stability of differences in the two types of calcareous opercula would favour a subgeneric separation of the two groups of species.

The close relationship of various naticid groups becomes more apparent if an analysis of diagnostic characters of some species is made. The New Zealand species *Tanea zelandica* (Quoy & Gaimard) resembles in shell form, funicle and unisulcate operculum the group of *Notocochlis* Powell, in shell ornament *Naticarius* Duméril, but in radular features (unicuspid rachidian and simple inner marginals) the species shows a close relationship to the Mediterranean species *Natica stercusmuscarum* (Gmelin) and the East Indian Ocean *N.lineata* (Röding). *Natica zonalis* Récluz, has all the features of the *Natica-Notocochlis* group, but the multisulcate operculum places the species in *Naticarius*. *Natica fasciata* (Röding) has the shape of *Tectonatica* Sacco, the operculum of *Notocochlis* and umbilical features which are intermediate between *Natica* s.str. and *Tectonatica*. It is evident that umbilical and opercular characters are not always in agreement nor do they follow a pre-diagnosed generic pattern. Since the differences in shape and extension of the parietal callus and the thickness of the funicle are often one of degree only, the group of species with unisulcate opercula *(Notocochlis* Powell) has been combined with *Natica* s.str. (bi- to trisulcate opercula).

Ecology and Animal

Tropical species of *Polinices* are common sand-dwellers of the intertidal

region, leaving wide tracks in the sand when on the move. Naticinae, however, prefer a sandy substratum mixed with weed and rarely expose themselves during daylight hours. The foot of *Polinices* is large and broad, and divides into a propodium and mesopodium (Fig. 1). The broad sole of the foot not only assists in locomotion over soft bottom but is also used for the purpose of propelling the animal forward through a propodial flipping motion. The animal of *Polinices* is able to retract completely into the shell after a short time lapse. The animal of *Natica* is smaller and retracts appreciably faster into its shell.

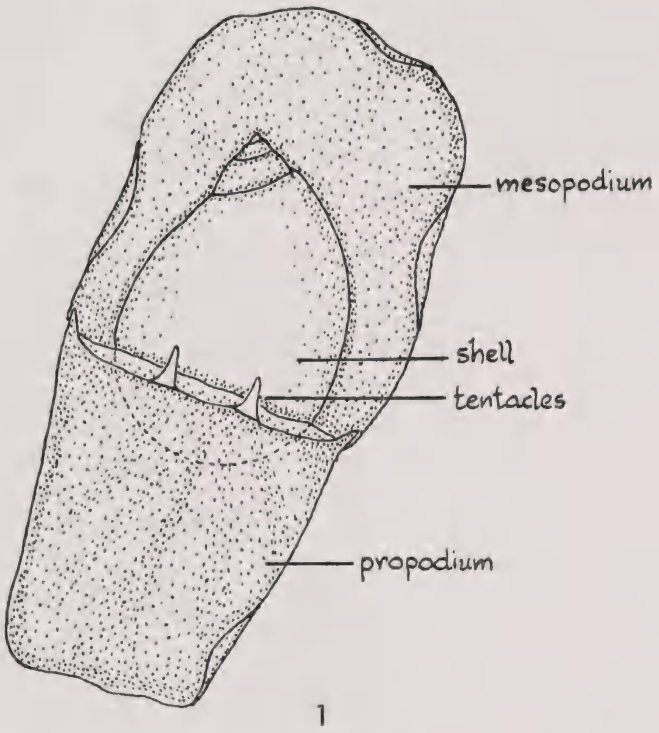

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Fig. 1. *Polinices tumidus* (Swainson). Dorsal view of animal.

Naticidae are carnivorous prosobranchs which gain access to other mollusc's soft parts by boring holes through their shells. The holes are regular, larger in diameter at the point of commencement than at the point of break-through, and incompletely bored holes show a central nodule in the depression. Data on the mechanism of boring and the composition of the accessory boring organ may be found in Ziegelmeier (1954).

Risbec (1956) reported on the anatomy of Naticidae from New Caledonia. This work, similarly to his work on the Mitridae from the same region, should be accepted with some reservations. Risbec (loc.cit.) lists specific names unaccompanied by authorities, and while the identity of some of his species is equivocal others have certainly been misidentified. The same author described the operculum of *Natica solida* Blainville (= *fasciata* Röding) as being corneous; the species is a true *Natica* which has a calcareous operculum, and Risbec's species was most probably a *Polinices*. The operculum of *Natica rufa* Born (= *vitellus* Linnaeus)

was said to have a single marginal rib, but the actual Pacific *N.vitellus* has not less than 2 marginal ribs. The operculum of Risbec's *"Natica zelandica"* was sculptured with 3 marginal ribs, but the New Zealand species *Tanea zelandica* (Quoy & Gaimard) has only a single marginal rib. Curiously enough, Risbec's figure of the radula of his *"N.zelandica"* does indeed represent the radula of a *Tanea* species (single large cusp on a concave rachidian), and the figured radula may have possibly belonged to *N.lineata* (Röding), a species which is known to have a *Tanea* type of radula.

SYSTEMATICS

KEY TO THE GENERA AND SUBGENERA OF FIJIAN NATICIDAE

Operculum calcareous, animal moderate in size, shell smooth or radially plicate at sutures ..... **Naticinae**

1. Operculum with 1-3 marginal ribs, funicle prominent or merging with umbilical wall, sometimes partially covered by parietal callus ..... **Natica** s.str.
2. Operculum multisulcate (6-8), funicle prominent, umbilicus open ..... **(Naticarius)**
3. Operculum with a single marginal rib, umbilicus almost or entirely covered by the parietal callus apart from a narrow lateral space ..... **(Tectonati**

Operculum corneous, animal large, shell smooth ..... **Polinicinae**

4. Shell heavy, solid, pyriform to pyriformly-ovate, umbilicus partially or completely filled with callus, funicle prominent ..... **Polinices** s.str.
5. Shell heavy, solid, ovate and compressed, funicle prominent, umbilical groove deep and semicircular ..... **(Neverita)**
6. Shell light in weight, pyriform, parietal callus narrow, partly folded over umbilicus, funicle indistinct ..... **(Mammilla)**

Operculum corneous, animal very large, shell spirally grooved ..... **Sininae**

7. Shell inflated, aperture semiovate, columellar callus narrow and folded over deep umbilicus ..... **Eunaticina**
8. Shell compressed, ear-shaped, aperture large and elliptical, umbilicus shallow ..... **Sinum**

Order MESOGASTROPODA

TAENIOGLOSSA

Superfamily NATICACEA

Family NATICIDAE Forbes, 1838

(Polinicidae Mörch, 1852, Cat. Conch. Com. Yoldi 1: 31)

Subfamily NATICINAE Forbes, 1838

Shell small to moderate in size, varicoloured, ornamented with bands, spots or axial flames; often smooth, occasionally sculptured with spiral striae or radial ribs at the sutures. Spire low, body whorl inflated, aperture semiovate, rarely ovate, smooth within, labial lip moderately thin. Umbilicus open, funicle well developed, occasionally covered by parietal callus.

The operculum is calcareous, unisulcate or multisulcate. The rachidian of the radula has 1-5 cusps in addition to 2 accessory basal cusps, lateral with 1-7 cusps; inner marginal generally bifid but occasionally simple, outer marginal always simple. Animal moderate in size, and able to retract completely into its shell.

Genus **Natica** Scopoli, 1777

Natica Scopoli, 1777, Introd. Hist. nat., p. 392. Type species by SD (Harris, 1897) *Nerita vitellus* Linnaeus, 1758. Recent, Indo-Pacific.

1798. *Cochlis* Röding, Mus. Bolten, p. 146. Type species by SD (Iredale, 1924) *Cochlis albula* Röding, 1798 = *Nerita vitellus* Linnaeus, 1758.

1826. *Nacca* Risso, Hist. nat. Eur. mérid. 4 : 148. Type species by SD (Herrmannsen, 1847) *Natica fulminea* (Gmelin) = *Nerita fulminea* Gmelin, 1791. Recent, West Africa.

1933. *Notocochlis* Powell, Trans. Proc. N.Z. Inst. 63: 166. Type species by OD *Cochlis migratoria* Powell, 1927. Recent, New Zealand.

Shell small to large, rounded and solid, spire low, smooth or with radial ribs at sutures; aperture wide, semiovate, umbilicus deep, posteriorly open or partly covered by the parietal callus, funicle weak or strong, entering umbilicus at right angles or obliquely. Parietal callus prominent, sometimes coalescing with funicle.

The operculum is calcareous, smooth and with 1-3 marginal ribs, columellar edge smooth or serrated.

Woodring (1957) considered the possibility that a type designation by Anton (1839) for *Natica* might be prior to the one by Harris (loc. cit.). Anton signalled his type designations by using "Versalbuchstaben" (Capital letters) for species so designated. In the section on *Natica* Lamarck (non Scopoli), Anton listed six species a-f, and none of these species have been singled out as the type; all six names are printed in italics; there was thus no type designation made by Anton.

Natica (Natica) vitellus (Linnaeus, 1758) (Figs. 2-5).

1758. *Nerita vitellus* Linnaeus, Syst. Nat. ed. p. 10, p. 77 (ref. Rumphius, pl. 22, fig. D).

1778. *Nerita rufa Born,* Ind. rer. nat. Caes. Vindob., p. 413 (ref. Rumphius, pl. 22, fig. D).

1781. *"Nerita dilute rufescens* Chemnitz", Syst. Conch. Cab. 5 : 258, pl. 187, figs. 1872-73 *(non binom.).*

1781. *"Nerita rufa* Chemnitz", Syst. Conch. Cab. 5 :259, pl. 187, figs. 1874-75 *(non binom.).*

1781. *"Nerita globosa laevis* Chemnitz", Syst. Conch. Cab. 5 : 267, pl. 188, figs. 189 a,b, 1897 *(non binom.).*

1786. *"Nerita fasciata* Martyn", Univ. Conch. 3 : pl. 110, right figure *(non. binom.).*

1791. *Nerita leucozonias* Gmelin, Syst. Nat., ed. 13, p. 3672 (ref. Kämmerer, pl. 12, figs. 5,6).

1791. *Nerita spadicea* Gmelin, Syst. Nat. ed. 13, p. 3672 (ref. Chemnitz, *op. cit.,* figs. 1872, 73).

1791. *Nerita spadicea* var. b, Gmelin, Syst. Nat. ed. 13, p. 3672 (ref. Chemnitz, *op.cit.,* figs. 1896 a,b, 1897).

1798. *Cochlis albula* Röding, Mus. Bolten., p.146 (ref. Chemnitz, *op. cit.,* figs. 1896 a,b, 1897).

1798. *Cochlis rufescens* Röding, Mus. Bolten., p. 148 (ref. Chemnitz, *op. cit.,* figs. 1872-73).

1807. *Natica fuscata* Link, Beschr. Nat.Samml. Univ. Rostock, p. 140 (ref. Chemnitz, *op.cit.,* figs. 1896 a,b, 1897).

1822. *Natica helvacea* Lamarck, Hist. nat. anim. s. vert. 6 :200 (ref. Chemnitz, *op. cit.,* figs. 1896 a,b, 1897).

1825. *Natica forscalii* Sowerby, Cat. shells Tank., p. 47 (ref. Chemnitz, 1795, Vol. 11, pl. 197, figs. 1901, 1902. Hab : Red Sea).

1849. *Natica pallens* Philippi, Zeit. Malakozool., p. 157.

1852. *Natica chemnitzii* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 15, pl. 2, figs. 3,4 (non Pfeiffer, 1840).

1852. *Natica (Nerita) globosa* "Chemnitz", Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 21, pl. 3, figs. 1,2 & pl. 8, fig. 5 (non Grateloup, 1828).

1855. *Natica globosa* Chemnitz, Reeve, Conch. Icon., pl. 11, figs. 46a,b (non Grateloup, 1828).

1855. *Natica forskalii* Chemnitz, Reeve, Conch. Icon., pl. 14, figs. 59 a,b.

1855. *Natica rufa* Born, Reeve, Conch. Icon., pl. 16, figs. 70 a,b.

1883. *Natica rufa* Born, Sowerby, Thes. Conchyl. 5 :80, pl. 4, fig. 42.

1953. *Natica rufa Lamack*, Mermod, Rev.Suisse Zool. 60(2) : 191, fig. 192.

1953. *Natica rufa Lamarck*, Mermod, Rev. Suisse Zool. 60(2) : 186, fig. 188 (figd. type).

1956. *Natica vitellus* Linné, Kaicher, Indo-Pacif. sea-shells, pl. 2, fig. 7.

1966. *Natica vitellus* (Linné), Habe & Kosuge, Shells world col. 2 :36, pl. 12, fig. 16 (forma *albula* Röding).

1967. *Natica vitellus* (Linné), Habe & Kosuge, Stand. book Jap. shells col. 3 :47, pl. 18, fig. 20.

Shell moderately large, 25-45mm in height, solid, spire low, smooth apart from fine growth striae which tend to be more prominent at the suture and early whorls. Variable in colour, white with a single broad brown zone on body whorl, or brown in colour with lower half of body whorl, central band and an area near suture white; nuclear whorls purplish-brown. Aperture wide, semi-ovate, white, marked with brown within; parietal callus thick but narrow, and extending only partially over posterior of umbilicus. Funicle ill-defined, often merging with umbilical wall; umbilicus open and deep.

The operculum (Fig. 4) is calcareous, white in colour, the columellar edge is serrated and the labial edge has 2 marginal ribs and the nucleus terminates in a somewhat callous knob.

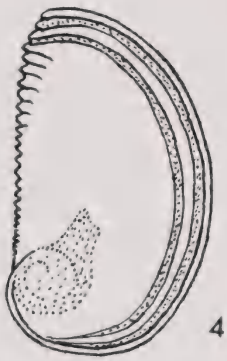
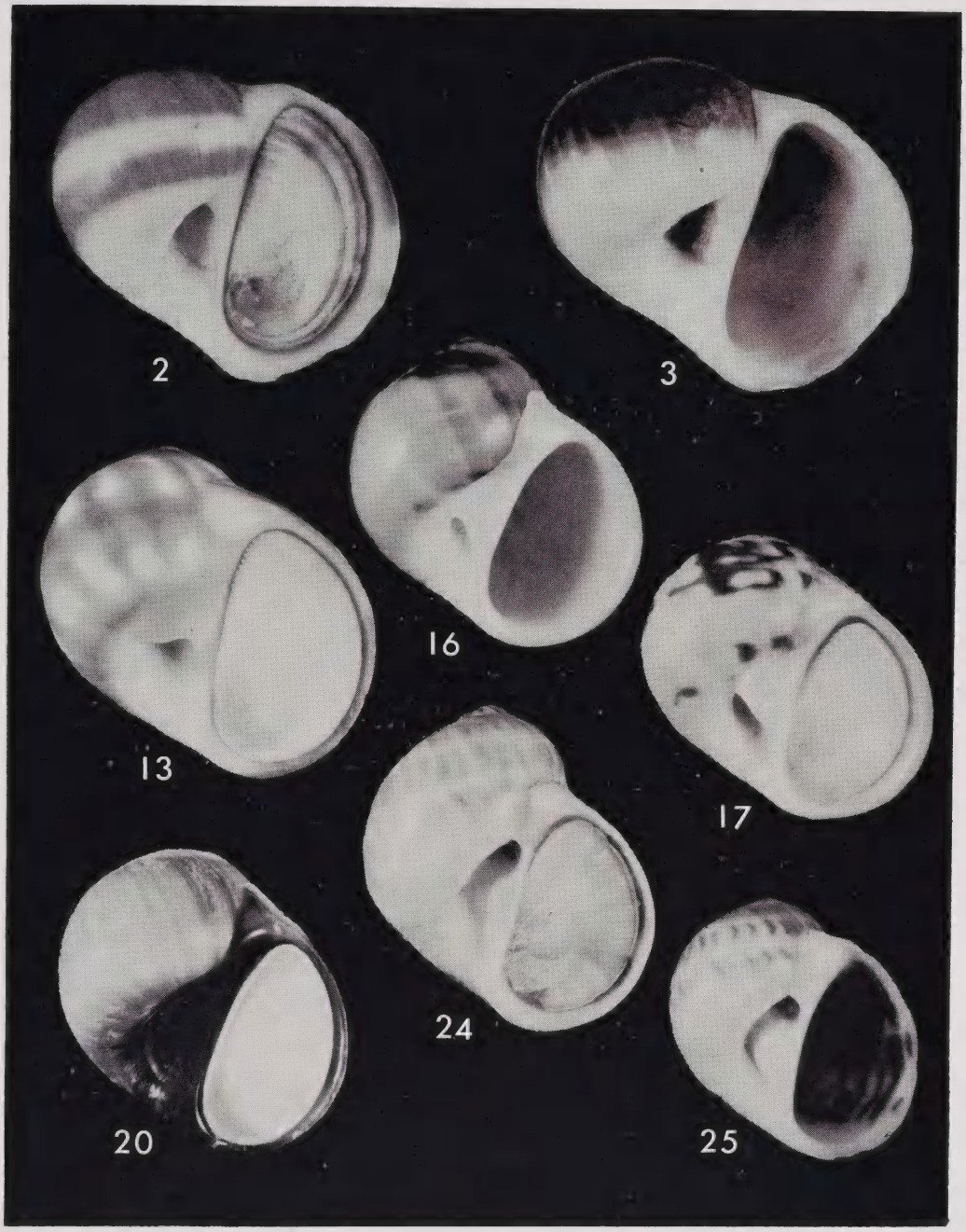


Fig. 4. *Natica vitellus* (Linnaeus). Operculum.

TYPE LOCALITY: Asiatic Ocean.

DISTRIBUTION AND ECOLOGY: The species is uncommon in the Fiji Islands and has been recorded from the north to the south along the western coast of Viti Levu. Clean coral-sand pockets and weedy-sand lagoons.



Figs. 2, 3, 13, 16, 17, 20, 24, 25. 2, 3. *Natica vitellus* (Linnaeus). 2. Nananu-i-Ra I., Fiji I.; height 29.4mm. 3. Manava I., Fiji I.; height 40.7mm. 13. *N. stellata* Hedley. Soepiori, Schouten I., West New Guinea; height 28.0mm (Powell coll., AIM). 16, 17. *N. arachnoidea* (Gmelin). Manava I., Fiii I.; height 19.1mm and 17.3mm respectively. 20. *N. fasciata* (Röding). Viti Levu Bay, Fiji I.; height 18.4mm. 24, 25. *N. gualtieriana* Récluz. Caboni beach, Fiji I.; height 23.3mm and 16.4mm respectively.

The forms *Natica rufa* (Born), *N.spadicea* (Gmelin) and *N.helvacea* Lamarck, are considered to be valid species by some authors; based on colour variants of the species, these forms do not display any major differences in umbilical or opercular features. *Natica stellata* (Hedley), however, which is a valid species, has been confused with *N.vitellus* and has been figured as that species by several authors. The superficially similar species *N.orientalis* (Gmelin), is uniformly brown in colour, the thick and prominent funicle enters the umbilicus at an oblique angle, the sutures have a flattened presutural ramp and the operculum is multisulcate. This species which has not been recorded from the Fiji Islands, has been correctly figured by Orr-Maes (1967,pl.9,fig.C).

Natica (Natica) stellata Hedley, 1913 (Figs. 6, 8-13)

1781. *"Nerita vitellus* Chemnitz", Syst. Conch. Cab. 5 : 255, pl. 186, figs. 1866-67 *(non binom.).*

1786. *"Nerita stellatus* Martyn", Univ. Conch. 3 : pl. 110, left figure *(non binom.).*

1798. *Cochlis vitellus* Röding, Mus. Bolten., p. 148 (ref. Chemnitz, *op. cit.*, pl. 186, figs. 1866-67) [non *Nerita vitellus* Linnaeus, 1758].

1807. *Natica vitellus* Link, Beschr. Nat.-Samml. Univ. Rostock, p. 140 (ref. Chemnitz, *op cit.* 186, figs. 1866-67 [non *Nerita vitellus* Linnaeus, 1758].

1855. *Natica vitellus* Reeve, Conch. Icon., pl. 10, figs. 39 a,b (non *Nerita vitellus* Linnaeus, 1758).

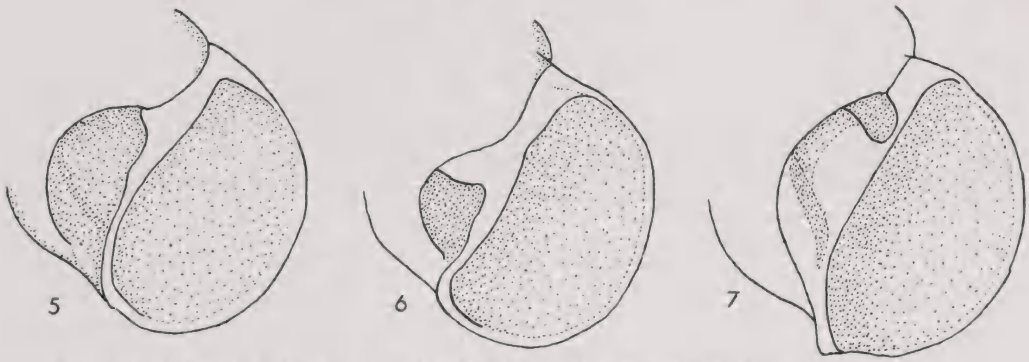
1883. *Natica vitellus* Sowerby, Thes. Conchyl. 5 :93, pl. 4, fig. 41 (non *Nerita vitellus* Linnaeus, 1758).

1913. *Natica stellatus* "Martyn", Hedley, Proc. Linn. Soc. (N.S.W.) 38(2) : 299 (ref. Martyn, *op. cit.*, pl. 110, figure on left).

1956. *Natica stellata* Hedley, Kaicher, Indo-Pacif. sea-shells, pl. 2, fig. 5.

1961. *Natica stellata* Chenu, Rippingale & McMichael, Gt. Barrier reef shells, p. 92, pl. 11, fig. 16.

Natica stellata Hedley, erroneously considered to be the *N.vitellus* of Linnaeus by 19th century authors, has not been recorded from the Fiji Islands. The species is similar in shape to *N.vitellus* but is a saturated orange in colour and ornamented with spiral rows of white spots on the body whorl. The pink parietal callus forms a tongue-shaped extension over the posterior of the umbilicus. The operclum (Figs. 10-11) is calcareous, white, and has 2-3 marginal ribs; the internal corneous operculum (Fig. 9) is attached along a central axis to the foot, but the edges are free. The rachidians of the radula (Fig. 8) are tricuspid, and the 2 basal accessory cusps are mounted on a broad shield; the lateral is tricuspid, inner marginal and



Figs. 5-7. Umbilical features. 5 *Natica vitellus* (Linnaeus). 6. *N. stellata* Hedley. 7. *Natica (Naticarius) orientalis* (Gmelin).

outer marginal simple. The examined specimen came from Soepiori, Schouten Islands, West New Guinea (Powell coll.).

The authorship of *N.stellata* is occasionally credited to Chenu, 1845, instead of Hedley. Chenu's re-publication of Martyn's non-binomial "The Universal Conchologist", does not validate specific names published in this work.

Natica (Natica) arachnoidea (Gmelin, 1791) (Figs. 14-17)

1781. *"Nerita lineis rufus* etc. Chemnitz", Syst. Conch. Cab. 5 :271, pl. 188, figs. 1915-16 *(non binom.).*

1791. *Nerita arachnoidea* Gmelin, Syst. Nat., ed. 13 p. 3674 (ref. Chemnitz, *op cit.* figs. 1915-16).

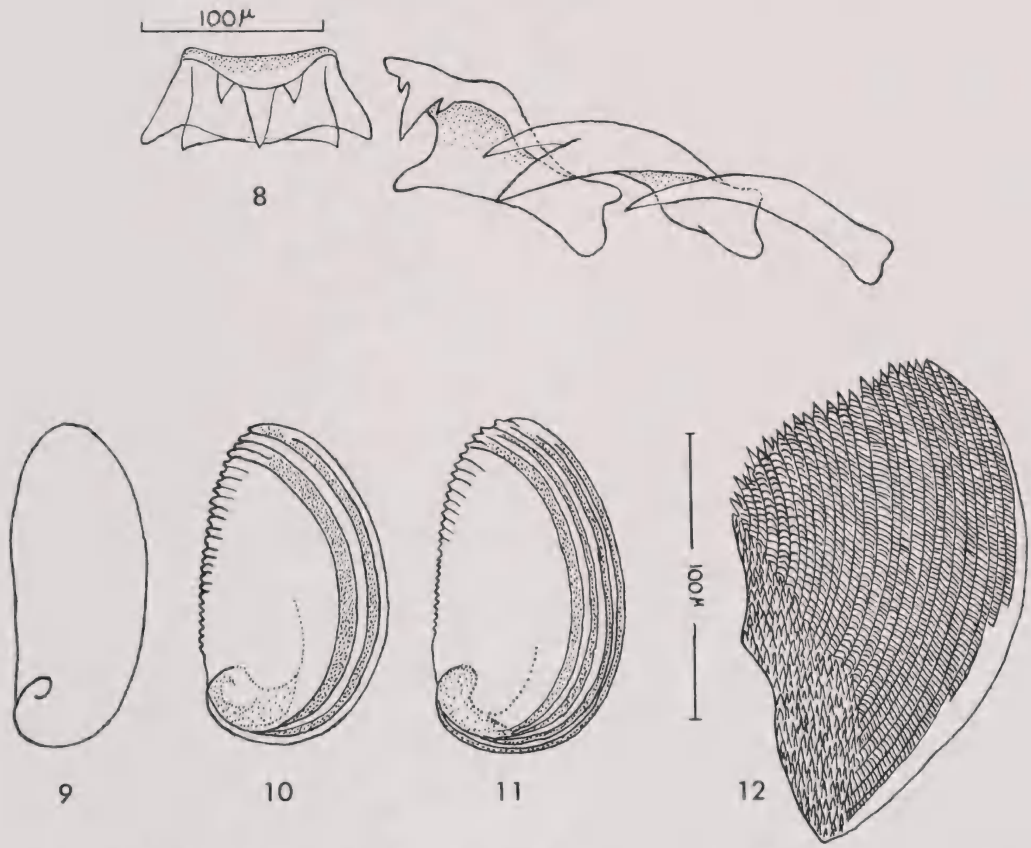
1844. *Natica raynoldiana* Récluz, Proc. Zool. Soc. Lond., pt. 11 : 212 (Hab : Zanzibar, Philippines & Ceylon).

1852. *Natica arachnoidea* Gmelin, Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 25, pl. 3, figs. 18,19 & pl. 15, fig. 18.

1855. *Natica raynaudiana* Récluz, Reeve, Conch. Icon., pl. 13, figs. 56 a,b.

1883. *Natica raynaudiana* Récluz,, Sowerby, Thes. Conchyl. 5 :90, pl. 7, fig. 88.

1909. *Natica arachnoidea* Gmelin, Schepman, Siboga-Exped. 49b(2) : 207.



Figs. 8-12. *Natica stellata* Hedley. 8. Half-row of radula. 9. Internal corneous operculum. 10, 11. Calcareous external opercula. 10. With 2 marginal ribs. 11. With 3 marginal ribs. 12. Single jaw plate.

1956. *Natica raynoldiana* Récluz, Kaicher, Indo-Pacif. sea-shells, pl. 1, fig. 13.

1961. *Notocochlis arachnoidea* Gmelin, Rippingale & McMichael, Queensl. & Gt. Barr. reef shells, p. 92, pl. 11, fig. 15.

1966. *Natica fulgrans* (sic) Récluz, Habe & Kosuge, Shells world col. 2:35, pl. 12, fig. 7 (non *Natica fulgurans* Récluz, 1844).

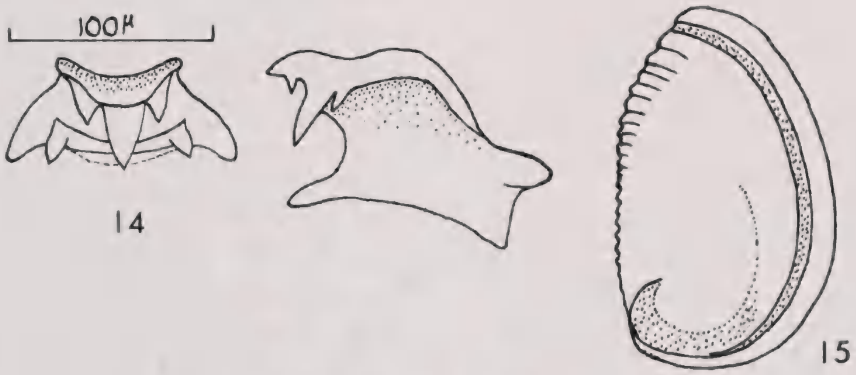
Shell moderately small, 10-25 mm in height, solid, spire low, smooth apart from fine axial growth striae. White, yellow or orange in colour, ornamented with irregular brown streaks, zones or lines, protoconch purplish-brown, umbilical area white. Aperture semiovate, funicle concealed under parietal callus which covers two-thirds to three-quarters of umbilical area; posterior umbilical depression of varying width.

The operculum (Fig. 15) is calcareous, white and unisulcate; periostracum thin, brown and opaque. The rachidian of the radula (Fig. 14) is tricuspid, the 2 basal accessory cusps are mounted on a narrow shield and the lateral is tricuspid; inner marginal bicuspid, outer marginal simple.

TYPE LOCALITY: None.

DISTRIBUTION AND ECOLOGY: The species is moderately common throughout the Fiji Islands. In weedy-sand of the intertidal zone.

Natica arachnoidea (Gmelin) and *N.raynoldiana* Récluz, were both based on the Indian Ocean form of the species, which has a cream base colour and a more regular, net-like ornamentation which is often arranged in a band-like formation.



Figs. 14, 15. *Natica arachnoidea* (Gmelin). 14. Rachidian and lateral of radula. 15. Operculum.

Natica (Natica) fasciata (Röding), 1798 (Figs. 18-20)

1781. *"Papilla seu Ruma Lupi* Chemnitz", Syst. Conch. Cab. 5:286, pl. 190, figs. 1940-41 *(non binom.)*.

1791. *Nerita melanostoma* var.e Gmelin, Syst. Nat. ed. p. 3674 (ref. Chemnitz, *op cit.*, figs. 1940-41 and Lister, pl. 559, fig. 2).

1798. *Albula fasciata* Röding, Mus. Bolten., p. 21 (ref. Chemnitz, *op. cit.* figs. 1940-41).

1825. *Natica solida* Blainville, Dict. Sci. Na. 34:251.

1825 *Natica solida* Blainville, Man. Malac. Conch., pl. 36 bis, fig. 8.

1830. *Natica cinnamomea* Menke, Syn. meth. Moll., pp. 47, 169 (ref. Gmelin, *Nerita melanostoma* var.e).

1838. *Natica lupinus* Deshayes in Deshayes & Edwards, Hist. nat. anim. s. vert. 8 :648 (ref. Chemnitz, *op. cit.*, figs. 1940-41 and Lister, pl. 559, fig. 2).

1852. *Natica cinnamomea* Menke, Philippi, Syst. Conch. Cab., 2nd ed. 2 (1) : 27, pl. 3, figs. 22,23.

1855. *Natica solida* Blainville, Reeve, Conch. Icon., pl. 16, figs. 71 a,b.

1883. *Natica solida* Blainville, Sowerby, Thes. Conchyl. 5 :88, pl. 6, fig. 81.

1956. *Natica solida* Blainville, Kaicher, Indo-Pacif. sea-shells, pl. 1. fig. 14.

1966. *Natica solida* Blainville, Habe & Kosuge, Shells world col. 2 :34, pl. 12, fig. 4.

Shell moderately small, 15-25 mm in height, solid, rounded and globose, spire short, sculptured with irregular growth striae. Light or dark brown in colour, ornamented with a lighter coloured band at suture and lower third of body whorl; the nuclear whorls purple in colour. Aperture semi-ovate, parietal callus dark chocolate-brown and shining, covering greater part of umbilicus, with the exception of an anterior umbilical opening. Area adjacent to umbilical groove dark brown. Periostracum light brown, thin and opaque.

The operculum (Fig. 19) is calcareous, white, with a single marginal rib and serrations on the columbellar edge. The radula (Fig. 18) has tricuspid rachidians, 2 accessory basal cusps, tricuspid laterals, bifid inner marginals and simple outer marginals.

TYPE LOCALITY: East Indies (Chemnitz, 1781).

DISTRIBUTION AND ECOLOGY: The species is rare in Fiji and has been recorded only from the north coast of Vitu Levu. In weedy-sand of the intertidal region.

The species has some resemblance to *Tectonatica* but the umbilical opening is larger in *Natica fasciata*, and the actual parietal callus extension leaves a narrow anterior opening.

Figs. 18, 19. *Natica fasciata* (Röding). 18. Half-row of radula. 19. Operculum.

Natica (Natica) gualtieriana Récluz, 1844 (Figs. 21-25)

1833. *Natica marochiensis* Gmelin, Quoy & Gaimard, Voy. Astrolabe 2 : 236, pl. 66, fig. 16, 17 (non *Nerita marochiensis* Gmelin, 1791).

1844. *Natica gualteriana* Récluz, Proc. Zool. Soc. Lond., pt. 11 : 208.

1849. *Natica tessellata* Philippi, Zeit. Malakozool. 5 :158 *(nom. subst. pro N. marochiensis* Quoy & Gaimard, 1833).

1852. *Natica tessellata* Philippi. Syst. Conch. Cab., 2nd ed. 2(1) : 48, pl. 7, fig. 7.

1855. *Natica gualteriana* Petit, Reeve, Conch. Icon., pl. 25, figs. 114, a.b.

1883. *Natica gualteriana* Petit, Sowerby, Thes. Conchyl. 5 : 81, pl. 9, fig. 152.

1907. *Natica gualtieriana* Couturier, J. Conchyl. 55: 165 *(nom. correct.).*

1934. *Natica (Natica) marochiensis* (Gmelin), Ladd, Bern. P. Bish. Mus. Bull. 119 : 209; pl. 36, figs. 2,3 (Tertiary of Viti Levu) [non *Nerita marochiensis* Gmelin, 1791].

1956. *Natica marochiensis* Gmelin, Kaicher, Indo-Pacif. sea-shells, pl. 1, fig. 11 (non *Nerita marochiensis* Gmelin, 1791).

1962. *Notocochlis luridus* (Philippi), Habe, Col. Illust. shells Jap. 2 :39, pl. 18, fig. 4 (non *Natica lurida* Philippi, 1836).

Shell moderately small, 8-25 mm in height, solid, spire moderately elevated, sculptured with axial growth striae and radial ribs at the sutures. White in colour, variously maculated with grey or brown, straight or curved streaks, generally arranged in 2-3 spiral zones on body whorl; some specimens dark greyish-brown, with streaks confluent. Aperture semi-ovate, maculated with brown within, funicle prominent, variable in thickness, axially elongate or rounded, extending vertically into umbilicus or winding sideways; umbilicus open or partially covered. Periostracum thin, brown and moderately translucent.

The operculum (Fig. 22-23) is calcareous, white and with a single marginal rib. The rachidian of the radula (Fig. 21) is tricuspid, the 2 basal cusps are mounted on a shield and the lateral has 7 cusps; the inner marginal is bifid and the outer marginal simple.

TYPE LOCALITY: Sual, Province of Pangasinan, Island of Luzon, Philippines.

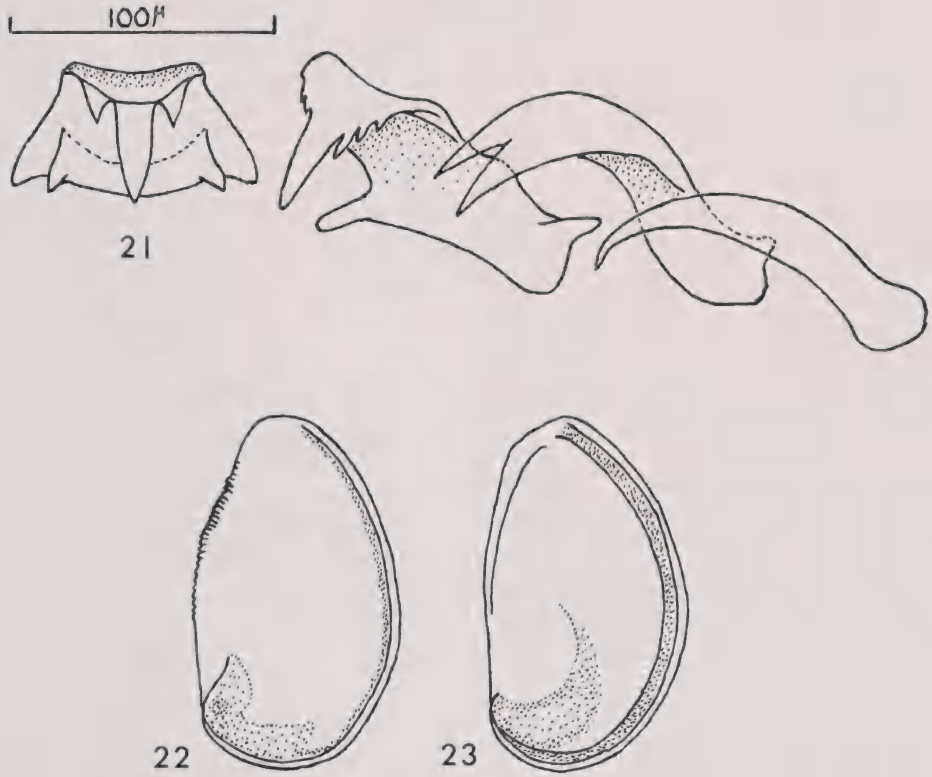
DISTRIBUTION AND ECOLOGY: The species is common throughout the Fiji Islands. In clean and muddy sand, intermixed with weed within the intertidal region; occasionally specimens are dredged from deeper water.

No naticid species has had a more confused taxonomic history than the common Indo-Pacific *Natica gualtieriana.* Chemnitz (1781) described the non-binomial" *Neritae maroccanae",* and supplied 6 figures on plate 188, figs. 1905-10. He recorded the species from the coasts of Africa, in particular Morocco and the Antilles. Gmelin (1791) described *Nerita marochiensis* and based his species on Chemnitz's illustrations and locality indication. Dillwyn (1817) renamed the species *Nerita maroccana,* cited all six of Chemnitz's figures, and gave as locality Africa, the West Indies and the Bay of Naples. Lamarck (1822) reported *Natica marochiensis* from Morocco, Antilles and Guiana. Lamarck's *N.marochiensis,* however, also contained specimens of the Caribbean *N.cayenensis* Récluz *(fide* Mermod, 1953). Quoy & Gaimard (1833) initiated the confusion by reporting *N.marochiensis* from the Central Pacific. Philippi (1836) named a *N.lurida* which he based on figures 1907-8 from Chemnitz, but which according to Pfeiffer (1840) was an error for figures 1909-10. Pfeiffer (loc.cit.) described *N.chemnitzii* from the west coast of Mexico, and cited Chemnitz's figures 1905-6 as illustrations.

Philippi (1852) in his revision of Naticidae, placed his *N.lurida* of 1836 in the synonymy of *"Natica maroccana* Chemnitz", and added the additional locality of Panama. On the next page, however, Philippi reports his variety *lurida* from Havana, Hawaii and the Ryukyu Islands. Reeve (1855) records *N.marochiensis* from North Africa and the West Indies and Sowerby (1883) from Panama, Guiana, the West Indies, Morocco and the Mediterranean.

From the foregoing notes it is evident that 19th century authors were overwhelmingly in favour for the Caribbean-Mediterranean region as the locality for *N.marochiensis*. As far as recent authors are concerned, Ladd (1934), Kaicher (1956) and Keen (1958) applied the name *N.marochiensis* to the Indo-Pacific species, while Hedley (1913), Powell (1927), Nicklés (1947) and Warmke & Abbott (1961) place *N.marochiensis* in the West African-Caribbean region.

It is clear that the usage of *N.marochiensis* by 20th century writers has been misapplied, and the name should be restricted to the species living in the Caribbean-Mediterranean region. For the rather similar West American species the name *N.chemnitzii* Pfeiffer, 1840 is available. *Natica sagittata* Menke is an East Australian species which is not conspecific with *N.gualtieriana* Récluz. MacNeil (1960) considered *N.sagittata* to be an Indonesian species, and confused the Caribbean *N.livida* Pfeiffer with the Indo-Pacific *N.gualtieriana*. *N.gualtieriana* and *N.marochiensis* are rather similar, but appear to be nevertheless separable. *Natica marochiensis* has a more globose shell, the spire whorls are more elevated and the



Figs. 21-23. *Natica gualtieriana* Récluz. 21. Half-row of radula. 22. Operculum without adjacent groove. 23. Operculum with adjacent grove.

nuclear whorls are purple in colour, but always white in *N.gualtieriana.* The columellar edge of the operculum and a narrow zone adjacent to the edge are always scabrous in *N.marochiensis* and *N.chemnitzii,* but smooth in *N.gualtieriana.*

Natica (Natica) areolata Récluz, 1844 (Figs. 26, 28-30)

1844. *Natica areolata* Récluz, proc. Zool. Soc Lond., pt. 11 : 206.
1852. *Natica areolata* Récluz, Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 67, pl. 11, fig. 2.
1886. *Natica areolata* Récluz, Tryon Man. Conch. 8 :25, pl. 6. fig. 23.

Shell small, 7-15 mm in height, thin and fragile, moderately globose, spire low. White in colour, ornamented with broad, arrow-shaped or curved, orange-brown axial markings arranged in 3 spiral zones on body whorl and separated by narrow white lines; in some specimens markings confluent, and shell smooth. Apertures semi-ovate, funicle white, prominent and spiralling up umbilicus; umbilicus open in some specimens but filled by funicle in others, leaving a narrow opening posteriorly.

The operculum (Fig. 26) is white, calcareous, and has 1-2 marginal ribs; the columellar edge is either smooth or finely serrated. The periostracum is thin, light brown in colour and moderately opaque.

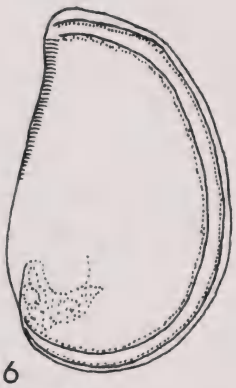


Fig. 26. *Natica areolata* Récluz. Operculum.

TYPE LOCALITY: Island of Capul, Philippines and Amboina.

DISTRIBUTION AND ECOLOGY: The species is moderately uncommon in the North and south of Viti Levu. In weedy coral-sand on offshore islands.

The species is rather similar to the East Australian *Natica sagittata* Menke, but in that species the ornamentation consists of close-set, curved or arrow-shaped lines and not broad zones.

Natica (Natica) pseustes Watson, 1881 (Fig. 27)

1881. *Natica pseustes* Watson, J. Linn. Soc. Lond. Zool. 15(85) : 255.
1886. *Natica pseustes* Watson, Rept. Voy. H.M.S. Challenger Zool. 15 :444, pl. 27, figs. 3 a,b,c.

Shell small, rounded, thin, glossy and porcellaneous transparent-white, dead white round umbilicus and also below suture; this white band flecked with irregular, sharply defined ruddy chestnut spots, a stain of this colour suffusing whole umbilicus and pillar. Remainder of shell covered with a delicate network of fine, sharply defined light chestnut lines; amidst this network two or three spiral zones with the brown lines sparser and with pale lanceolate spots. Sculptured with delicate hair-like lines of growth, strongest and most crowded near suture and round umbilicus; a very faint appearance of rounded threads and furrows, one of which below suture a little stronger than the rest, and surface densely, delicately, sharply, microscopically scratched. Mouth very oblique, semicircular, but pointed above and rounded below, with a slight angulation at front of pillar. Spire scarcely raised, but just perceptibly conical, apex large, sutures almost horizontal and very slight. Umbilicus consisting only of the channel or gutter, which twists round the pillar callus and disappears behind it. (Condensed original description). Height 0.327 in.(= 8.31 mm).

Fig. 27. *Natica pseustes* Watson. Levuka, Fiji Islands. Holotype B.M.N.H. No. 1887.2.9.1361; height 8.3mm.
(Photograph courtesy of Dr J. D. Taylor, British Museum (Nat. Hist.), London)

TYPE LOCALITY: Levuka, Fiji Islands. Shallow water.

No recent specimens answering to Watson's description have been recorded from the Fiji Islands. Watson (1881) considered *Natica pseustes* to be identical with specimens of a species dredged by McAndrew at the Gulf of Suez. A photograph of the holotype of *N.pseustes* (Fig. 27) was recently received. Watson's *N.pseustes* appears to be a small specimen of *N.arachnoidea* (Gmelin).

Subgenus **Naticarius** Duméril, 1806

Naticarius Duméril, 1806, Zool.Analyt., p.164. Type species by SM (Froriep, 1806) *Nerita canrena* Linnaeus, 1758. Recent, West Indies.

1810. *Naticus* Montfort, Conch. Syst. 2:219. Type species by OD *Naticus canrenus* Linné = *Nerita canrena* Linnaeus, 1758.

1962. *Naricarius* Duméril, Macpherson & Gabriel, Mar. Moll. Victoria, p. 138 *(nom. null.)*.

Shell moderately small to large, solid, rounded and inflated, smooth or axially wrinkled at sutures; aperture semi-ovate, smooth within, umbilicus deep, parietal callus distinct and slightly overlapping funicle, funicle broad, penetrating umbilicus without completely filling it.

The operculum is calcareous and multisulcate. The radula is basically the same as in *Natica* s.str.

Iredale (1916) considered Duméril's names to be substitute names for genus-groups established by earlier authors. In the case of *Naticarius* Duméril, there is no evidence in the text that *Naticarius* has been proposed as a replacement name for either *Natica* Scopoli or *Natica* Lamarck, and the citation lacks any reference to previous authors. The genera *Phyllidia, Scyllaea, Aplysia, Valvearius, Purpurarius, Salpa* and *Thalia* have been credited by Duméril (1806) to prior authors, and as such are considered "unjustified emendations" wherever applicable. *Naticarius* Duméril is considered to be a new genus-group without included nominal species, and Froriep's (1806) inclusion of *Nerita canrena* as a single example for *Naticarius* is considered to be a type designation by subsequent monotypy.

Natica (Naticarius) alapapilionis (Röding, 1798) (Fig. 32)

1781. *"Ala papilionis* Chemnitz", Syst. Conch. Cab. 5:257, pl. 186, figs. 1868-71 *(non binom.)*.

1798. *Cochlis alapapilionis* Röding, Mus. Bolten, p. 146 (ref. Chemnitz, *op. cit.*, figs. 1868-71).

1816. *Natica zonaria* Lamarck, Tabl. Encycl. Méth., p. 11, pl. 453, figs. 2 a,b.

1828. *Natica taeniata* Menke, Synop. meth. Moll., p. 26 (ref. Chemnitz, *op. cit.* figs. 1868-71).

1852. *Natica articulata* Philippi, Syst. Conch. Cab., 2nd ed. 2(1): 119, pl. 17. figs. 4,8.

1853. *Natica crenata* Récluz, J. Conchyl. 4(3): 32, pl. 7, figs. 4, 5 (Philippines).

1956. *Natica alapapilionis* Röding, Kaicher, Indo-Pacif. sea-shells, pl. 1, fig. 15.

1966. *Notocochlis alapapilionis* (Röding), Habe & Kosuge, Shells world col. 2:35, pl. 12. fig. 11.

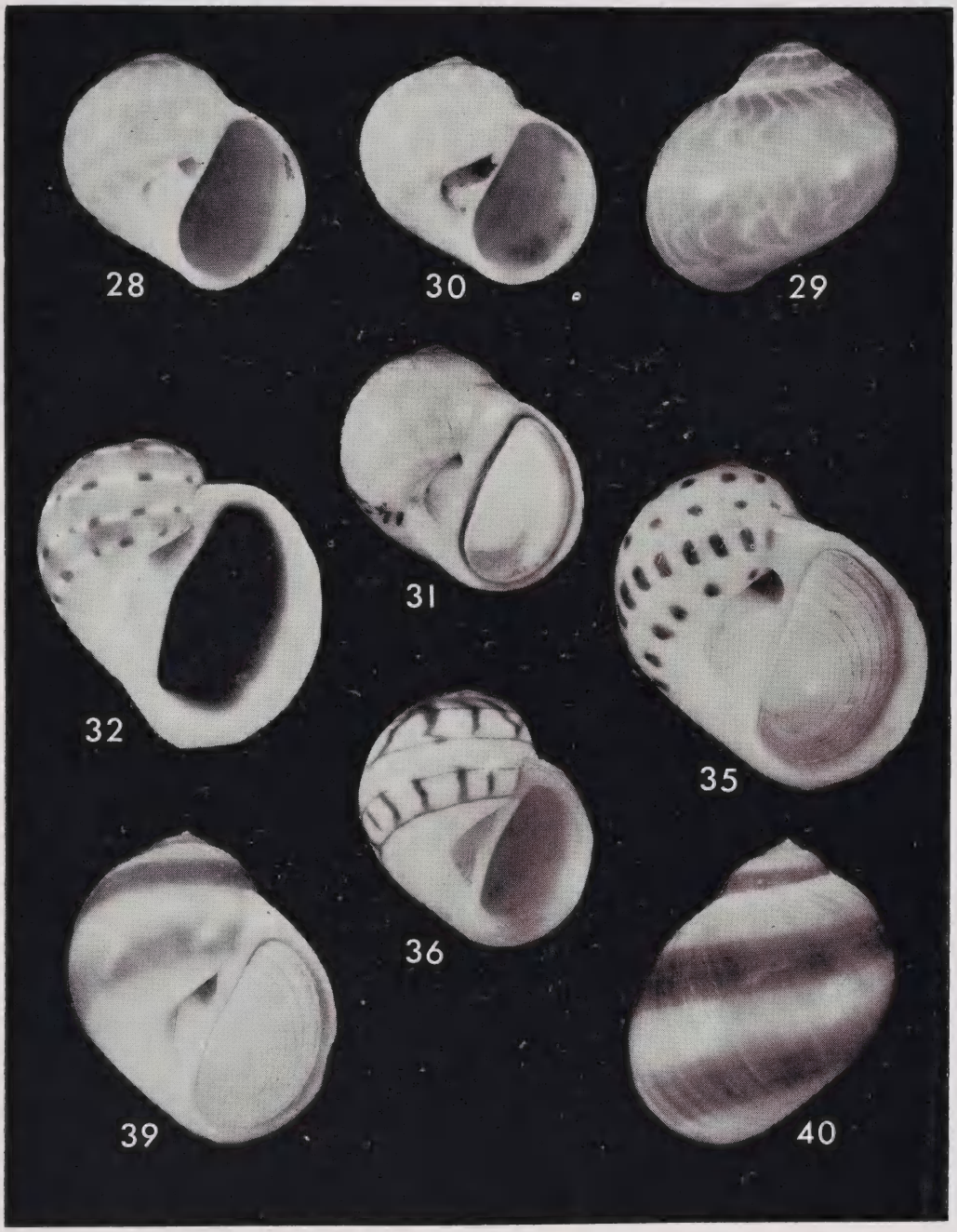
1967. *Naticarius alapapilionis* (Röding), Habe & Kosuge, Stand. book Jap. shells col. 3:47, pl. 18, fig. 18.

Shell moderate in size, 15-30 mm in height, light in weight, spire short, smooth apart from radial ribs at sutures. Light brown, tan or purplish-brown in colour, ornamented with 4 narrow, linear zones of alternating, horizontally oriented dark brown and white spots; umbilical area white, spire whorls violet. Aperture wide, semi-ovate, purplish within, edge of labial lip white. Umbilicus open and extending anteriorly, parietal callus confined to juncture of aperture with body whorl, funicle slender, entering umbilicus at an oblique angle.

The operculum is calcareous, white and multisulcate.

TYPE LOCALITY: Indian Ocean and Philippines (Deshayes & Edwards, 1838).

DISTRIBUTION AND ECOLOGY: The species is moderately rare in Fiji, and has been recorded from offshore islands east of Viti Levu. In intertidal weedy sand pools.



Figs. 28-32, 35, 36, 39, 40. 28-30. *Natica areolata* (Rēcluz). Caboni Beach, Fiji I. 28-29. Height 14.4mm. 30. Height 14.2mm. 31. *Cochlis migratoria* Powell, 1927. Parengarenga Harbour, New Zealand, intertidal. Holotype Powell coll., AIM No. TP-1465; height 15.0mm. Type species of *Notocochlis* Powell, 1933. 32. *Natica (Naticarius) alapapilionis* (Röding). Leleuvia I., Fiji I.; height 21.7mm. 35. *N. (N.) onca* (Röding). Caboni beach, Fiji I.; height 23.7mm. 36. *N. (N.) lineozona* Jousseaume, 1874. Lomalagi, Fiji I.; height 9.4mm. 39, 40. *N. (N.) zonalis* Rēcluz. Manava I., Fiji I.; height 18.6mm.

Natica (Naticarius) onca (Röding, 1798) (Figs. 33-35)

1781. *"Pavimentum chinense* Chemnitz", Syst. Conch. Cab. 5 :264, pl. 187, figs. 1887-91 *(non binom.).*

1798. *Cochlis onca* Röding, Mus. Bolten. p. 147, (ref. Chemnitz, *op. cit.* figs. 1887-88).

1798. *Cochlis pavimentum* Röding, Mus. Bolten. p. 147 (ref. Chemnitz, *op cit.*, figs. 1889-90).

1806. *Natica litterata* Link, Beschr. Nat.-Samml. Univ. Rostock, p. 140 (ref. Chemnitz, *op cit.*, figs. 1881-91 = error for figs. 1887-91).

1816. *Natica chinensis* Lamarck. Tabl. Encycl. Méth., p. 10, pl. 453, figs. 3 a,b.

1825. *Nerita candida* Wood, Ind. Testac., p. 169, pl. 35, fig. 2a.

1855. *Natica chinensis* Lamarck, Reeve, Conch. Icon., pl. 19. figs. 82 a,b.

1883. *Natica chinensis* Lamarck, Sowerby, Thes. Conchyl. 5 :83, pl. 1, fig. 9.

1953. *Natica chinensis* Lamarck, Mermod, Rev. suisse Zool. 60(2) : 199, fig. 198 (figd. type).

1956. *Natica onca* Röding, Kaicher, Indo-Pacif. sea-shells, pl. 2, fig. 4.

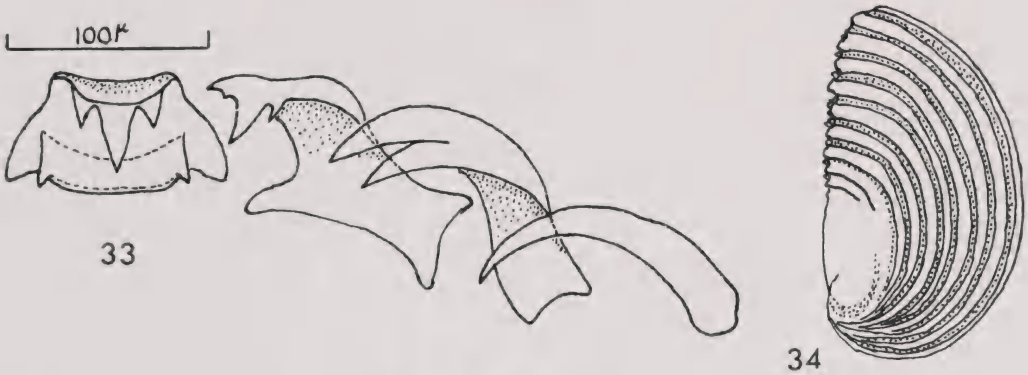
1966. *Naticarius onca* (Röding), Habe & Kosuge, Stand. book Jap. shells col. 3 : 46, pl. 18, fig. 10.

Shell moderate in size, 10-25 mm in height, solid, spire low, sculptured with fine, close-set growth striae, sutures with prominent or obsolete radial ribs. White or cream in colour, ornamented with 5 spiral rows of evenly spaced, dark brown quadrate spots on the body whorl; nuclear whorls white. Aperture semi-ovate, white within, parietal callus prominent at juncture of aperture, umbilicus open posteriorly, funicle broad and prominent, entering umbilicus at an oblique angle, umbilical groove prominent. Periostracum light brown, thin and semi-translucent.

The operculum (Fig. 34) is calcareous, white, and multisulcate (with 7-8 ribs). The radula (Fig. 33) of *Naticarius* is basically the same as in *Natica* s.str.: the rachidians are tricuspid with 2 basal cusps at the base, and the lateral is tricuspid; the inner marginal is bifid, and outer marginal simple.

TYPE LOCALITY: Moluccas (Chemnitz, 1781).

DISTRIBUTION AND ECOLOGY: The species is moderately common throughout the Fiji Islands. In weedy, clean or muddy sand of the intertidal region.



Figs. 33, 34. *Natica (Naticarius) onca* (Röding). 33. Half-row of radula. 34. Operculum.

Natica (Naticarius) lineozona Jousseaume, 1874 (Fig. 36)

1874. *Natica lineozona* Jousseaume, Rev. Mag. Zool. (3) 2:22. pl. 11, figs. 3,4 (January 1874).

1874. *Natica gaidei* Souverbie in Souverbie & Montrouzier, J. Conchyl. 22:196, pl. 7, fig. 7 (April 1874).

1875. *Natica gaidei* Souverbie, J. Conchyl. 23:292, pl. 13, fig. 8 (operculum).

1883. *Natica notata* Sowerby, Thes. Conchyl. 5:83, pl. 9, fig. 168.

1967. *Natica lineozona* Jousseaume, Orr-Maes, Proc. Acad. Nat. Sci. Phild. 119(4): 120, pl. 9, fig. B (Cocos-Keeling I.).

Shell small, 5-10 mm in height, moderately solid, spire short, smooth. White in colour, ornamented with 4 dark brown spiral lines and irregular, straight or curved axial streaks; the axial markings confined within anterior zone, but extending over posterior zone a short distance towards suture. Aperture semi-ovate, parietal callus narrow and moderately thin, only partially overlapping the umbilicus; funicle indistinct, partly merged with umbilical wall, umbilicus open. Periostracum light brown, thin and opaque.

The operculum is calcareous, white and multisulcate *(fide* Souverbie, 1875).

TYPE LOCALITY: Lifu, Loyalty Islands (Souverbie in Souverbie & Montrouzier, 1874).

DISTRIBUTION AND ECOLOGY: The species is rare in the Fiji Islands and has been recorded from the South coast of Viti Levu. In coral sand of reef tide-pools.

Figs. 37, 38. *Natica (Naticarius) zonalis* Récluz. 37. Half-row of radula. 38. Operculum.

Natica (Naticarius) zonalis Récluz, 1850 (Figs. 37-40)

1850. *Natica zonal*is Récluz, J. Conchyl. 1(4): 386, pl. 14, fig. 9 (shell) fig. 10 (operculum).

1886. *Natica zonalis* Récluz, Tryon, Man. Conch. 8:29, pl. 8, fig. 61.

1961. *Naticarius gualtierianus* Rippingale & McMichael, Queensl. & Gt. Barr. reef shells, p. 91, pl. 11, fig. 13. (non *Natica gualteriana* Récluz 1844).

Shell moderately small, 10-20 mm in height, ovate and sub-globular, solid, spire short, nuclear whorls elevated; sculptured with fine growth striae which form prominent

radial riblets at sutures. White or light brown in colour, ornamented with 2 moderately broad, dark brown bands on body whorl, and a single band of same colour at suture of penultimate whorl; in some specimens the 2 bands become confluent. Aperture semi-ovate parietal callus narrow, funicle moderate in size, entering umbilicus at an oblique angle; umbilicus open posteriorly. Periostracum light brown, thin and opaque.

The operculum (Fig. 38) is calcareous, white and multi-sulcate (7-9 ribs). The rachidians of the radula (Fig. 37) are tricuspid, two additional basal cusps are mounted on a shield and the lateral is tricuspid; inner marginal is bifid, outer marginal simple.

TYPE LOCALITY: Fiji Islands.

DISTRIBUTION AND ECOLOGY: The species is moderately uncommon in Fiji, and occurs in widely scattered localities throughout the group. In clean coral sand, interspersed with weed, in the intertidal zone.

Rippingale & McMichael's *Naticarius gaultierianus* from Queensland appears to be *Natica zonalis;* the figured operculum is multisulcate, whereas *Natica gualtieriana* has a unisulcate operculum. *Natica philippinensis* Watson, 1881, is probably a small specimen of *N.zonalis.*

Subgenus **Tectonatica** Sacco, 1890

Tectonatica Sacco, 1890, Boll. Mus. Zool. Anat. Univ. Torino 5(86) : 33. Type species by M *Natica tectula* Bors. = *N.tectula* Sacco, 1890. Mio-Pliocene of Italy.

1892. *?Cryptonatica* Dall, Trans. Wag. Free Inst. Sci. 3 :362. Type species by SD (Dall, 1909) *Natica clausa* Broderip & Sowerby, 1829. Arctic to N.W. Pacific.

Shell small to medium sized, moderately solid, rounded and smooth; aperture semi-ovate, umbilicus almost completely filled with callus, callus bordered by a groove.

According to Wenz (1941), the operculum is calcareous and smooth (and presumably unisulcate ?).

The authorship of *Natica tectula* is generally credited to Bonelli, without a date, and Glibert gives 1826 as the year of authorship. Bonelli's name *N.tectula* appeared in a manuscript catalogue of shells in the Turin Museum, entry No. 3480 *(fide* Sorgenfrei, 1958), and is an unavailable name. The authorship is here credited to Sacco, but a prior validation may be in existence.

Natica (Tectonatica) bougei Sowerby, 1908 (Figs. 41-43)

1908. *Natica bougei* Sowerby, Proc. Malac. Soc. Lond. 8 (1): 17, pl. 1, fig. 3.

Shell small, 4-9 mm in height, pyriformly-ovate, spire short; sculptured with fine axial growth striae which form obsolete radial riblets at sutures. White in colour, ornamented with irregular, wavy or zigzag, blackish-brown axial lines on body whorl; in some specimens the lines coalesce and form small blotches. Aperture semi-ovate, parietal callus moderately broad, completely filling umbilicus; parietal callus slightly concave anteriorly, a narrow umbilical marginal groove bordering the callus.

The operculum (Fig. 41) is calcareous, white, unisulcate, and the columellar edge lacks serrations.

TYPE LOCALITY: New Caledonia.

DISTRIBUTION AND ECOLOGY: The species is moderately rare in Fiji, and has been recorded from the North and South coasts of Viti Levu. In clean coral sand of offshore islands.

The species conforms to the diagnosis of *Tectonatica,* and the somewhat oblique elongation of the type species is also evident in *Natica bougei.*

Fig. 41. *Natica (Tectonatica) bougei* Sowerby. Operculum.

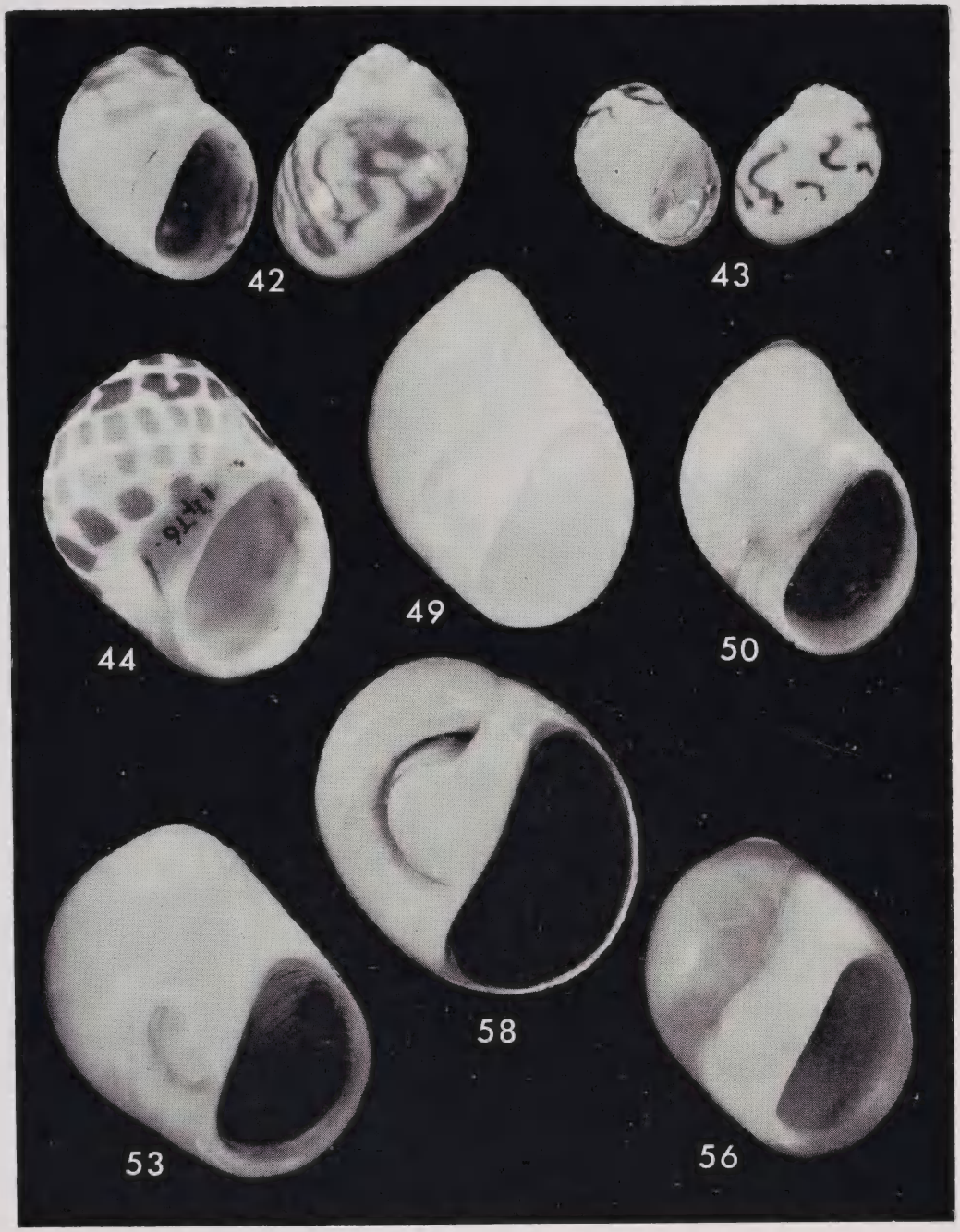
Natica (Tectonatica) violacea Sowerby, 1825 (Fig. 44)

1825. *Natica violacea* Sowerby, Cat. shells Tankerv., App. p. 11.
1828. *Nerita glabra* Wood, Suppl. Ind. Testac., p. 26, pl. 8, fig. 14.
1842. *Natica rhodostoma* Philippi, Abb. Beschr. Conchyl. 1(1) : 16, pl. 1, fig. 7.
1852. *Natica violacea* Sowerby, Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 66, pl. 10, fig. 13.
1855. *Natica violacea* Sowerby, Reeve, Conch. Icon., pl. 15, figs. 65 a,b.
1883. *Natica violacea Sowerby,* Sowerby, Thes. Conchyl. 5 :89, pl. 1, fig. 11.
1966. *Natica violacea* Sowerby, Habe & Kosuge, Shells world col. 2 :34, pl. 12, fig. 2.

Shell moderately small, 15-20 mm in height, solid, pyriformly-ovate and subglobular, spire short; sculptured with fine axial growth striae, sutures grooved. White in colour, ornamented with 5 spiral rows of irregular, sometimes rhomboidal spots or wavy lines on body whorl and 1 row of spots on penultimate whorl; parietal callus and base of shell rosy-violet in colour. Aperture semi-ovate, parietal callus completely covering umbilicus apart from a narrow umbilical marginal groove.

TYPE LOCALITY: East Indies.

DISTRIBUTION: The species is apparently rare in the Fiji Islands, and only one dead specimen has so far been collected. This specimen is unsuitable for a photograph and a specimen from Tautira, Tahiti (Powell coll.), has been illustrated instead.



Figs. 42-44, 49, 50, 53, 56, 58. 42, 43. *Natica (Tectonatica) bougei* Sowerby. Nananu-i-Ra I., Fiji I.; height 8.5mm and 5.8mm respectively. 44. *N. (T.) violacea* Sowerby. Tautira, Tahiti (Powell coll.); height 20.0mm. 49, 50. *Polinices tumidus* (Swainson). Manava I., Fiji I.; height 45.5mm and 24.0mm respectively. 53. *P. flemingiana* (Récluz). Manava I., Fiji I.; height 45.4mm. 56. *P. aurantius* (Röding). Manava I., Fiji I.; height 25.5mm. 58. *Polinices (Neverita) albumen* (Linnaeus). Manava I., Fiji I.; height 35.4mm.

Subfamily POLINICINAE Gray, 1847 (ex-Polinicina)

(= Mammillinae Iredale & McMichael, 1962, Mem. Aust. Mus. 11: 57.)

Genus **Polinices** Montfort, 1810

Polinices Montfort, 1810, Conch.Syst. 2:223. Type species by OD *Polinices albus* Montfort, 1810 = *Nerita mamilla* Linnaeus, 1758. Recent, Caribbean.

1798. *Albula* Röding, Mus. Bolten., p. 20. Type species by SD (Winkworth, 1945) *Albula mammilla* Röding, 1798 = *Mamillaria tumida* Swainson, 1840. Recent, Indo-Pacific. (Non *Albula* Osbeck, 1762; nec. Scopoli, 1777).

1830. *Polynices* Menke, Syn. meth. Moll., ed. 2, p. 47 and auctt. *(nom. null).*

1834. *Naticina* Guilding, Trans. Linn. Soc. Lond. 17 :30. Type species by OD *N.lactea* Guilding, 1834.

1840. *Naticella* "Guilding", Swainson, Treat. Malac., p.345. Type species by M. *N.aurantia* Martini = *Albula aurantium* Röding, 1798.

1852. *Mamma* "Klein", Mörch, Cat. Conchyl. Com. Yoldi, fasc. 1 :133 (publ. in synonymy of *Polinices* Montfort).

1852. *Pollinices* Mörch, Cat. Conchyl. Com. Yoldi, fasc. 1: 132 *(nom. null).*

1882. *Uber* "Humphrey', Dunker, Ind. Moll. Mar. Japon., p. 62. Type species by SD (Hedley,1924) *Nerita mamilla* Linnaeus,1758.

Shell moderate in size, inflated, solid, porcellaneous and smooth apart from irregular growth striae; sutures indistinct and adpressed, aperture semi-ovate, smooth within, umbilicus broad and deep, partly or completely covered by the umbilical callus, parietal callus prominent, funicle coalesced with umbilical callus.

The operculum is corneous. The radula is basically similar to the radula of *Natica.*

Some authors have equalled *Polinices albus* Montfort to *Nerita mamilla* Linnaeus, but Woodring (1957) places *Polinices albus* in the synonymy of the Caribbean *Natica brunnea* Link, 1807 (= *Albula hepatica* Röding, 1798). The species *Polinices hepaticus* (Röding) is a tan or orange-brown species, but *P.albus* is a pure white species resembling the Caribbean *P.lacteus* (Guilding). Montfort's references for his *P.albus* are to the white Linnaean *Nerita mamilla,* Columna's and Lister's *"Cochlea nivea",* Rumphius' *"Valvata albula"* and d'Argenville's *"Ubertenue albidum"* and *"Mammelon blanc". Polinices albus* is most probably synonymous with *Nerita mamilla* Linnaeus, a dubious taxon which may be an earlier name for *Polinices lacteus* (Guilding) from the West Indies. For further discussions see under *P.tumidus* (Swainson).

Winkworth (1945) listed *Albula mamilla* Röding, as the type species of *Albula* by tautonymy. Röding (1798) did not cite a specific name *"albula"* either as a valid name or synonym, and Winkworth's nomination of *Albula mammilla* Röding is a type selection by subsequent designation.

Polinices (Polinices) tumidus (Swainson, 1840) (Figs. 45, 47-50)

1781. *"Mamma albula* Chemnitz", Syst. Conch. Cab. 5 :280, pl. 189, figs. 1928-31 *(non binom.).*

1798. *Albula mammilla* Röding, Mus. Bolten., p. 20 (ref. Chemnitz, *op.cit.,* figs. 1928-31) [non *Nerita mamilla Linnaeus,* 1758].

1840. *Mamillaria tumida* Swainson, Treat. Malac., p. 345 (ref. Chemnitz, *op. cit.,* figs. 1928-31).

1844. *Natica pyriformis* Récluz, Proc. Zool. Soc. Lond., pt. 11 :211.

1851. *Natica albula* Récluz, J. Conchyl. 2(2) : 194 (ref. Rumphius, pl. 22, fig. F).

1852. *Natica ponderosa* Philippi, Syst. Conch. Cab. 2nd ed. 2(1) : 32, pl. 4, figs. 9,10.

1852. *Natica cygnea* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 80, pl. 12, fig. 6.

1855. *Natica pyriformis* Récluz, Reeve, Conch. Icon., pl. 5, fig. 16.

1855. *Natica mamilla* Linnaeus, Reeve, Conch. Icon., pl. 7, fig. 27 (Non *Nerita mamilla* Linnaeus, 1758).

1883. *Natica mamilla* Linnaeus, Sowerby, Thes. Conchyl. 5 : 85, pl. 3, figs. 28-30 (non *Nerita mamilla* Linnaeus, 1758).

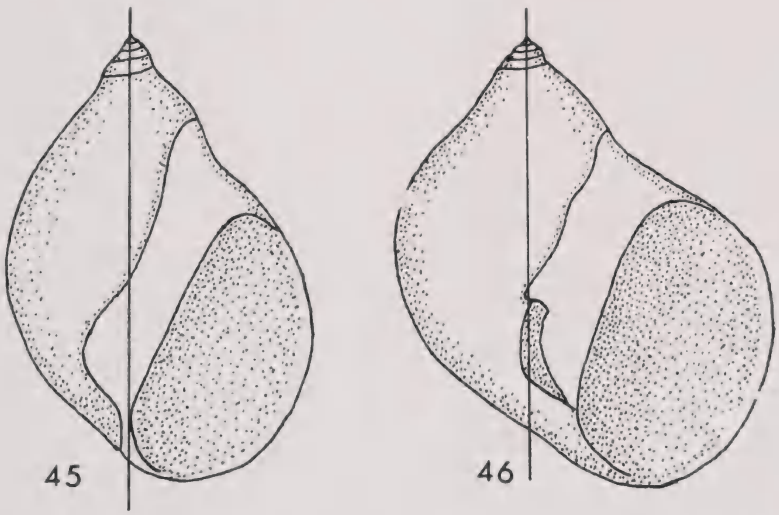
1934. *Polinices (Polinices) mamilla* (Linnaeus), Ladd, Bern. P. Bish. Mus. Bull. 119 : 210, pl. 36, figs. 4, 5 (non *Nerita mamilla* Linnaeus, 1758).

1967. *Polynices pyriformis* (Récluz), Habe & Kosuge, Stand. book Jap. shells col. 3 :45, pl. 18, fig. 7.

Shell small to large, 13-50 mm in height, pyriformly-ovate, spire axis bisecting anterior end of columella (Fig. 45). Porcellaneous-white in colour, occasionally with dark striae or ill-defined spots at sutures; immature specimens banded with a light bluish-grey zone on body whorl and at sutures. Spire short, protoconch minute, aperture wide and semi-ovate. Umbilicus completely covered by a heavy callus in adult specimens, a small anterior umbilical groove present in juveniles.

The operculum (Fig. 48) is corneous, light brown in colour, with a dark brown zone adjoining the columellar edge. The radula (Fig. 47) has tricuspid rachidians which have 2 additional basal cusps, and tricuspid laterals; the inner marginals are bifid, outer marginals simple. The jaws are similar to those of *P.aurantius* (Röding).

TYPE LOCALITY: East Indies and Tranquebar (Chemnitz, 1781).

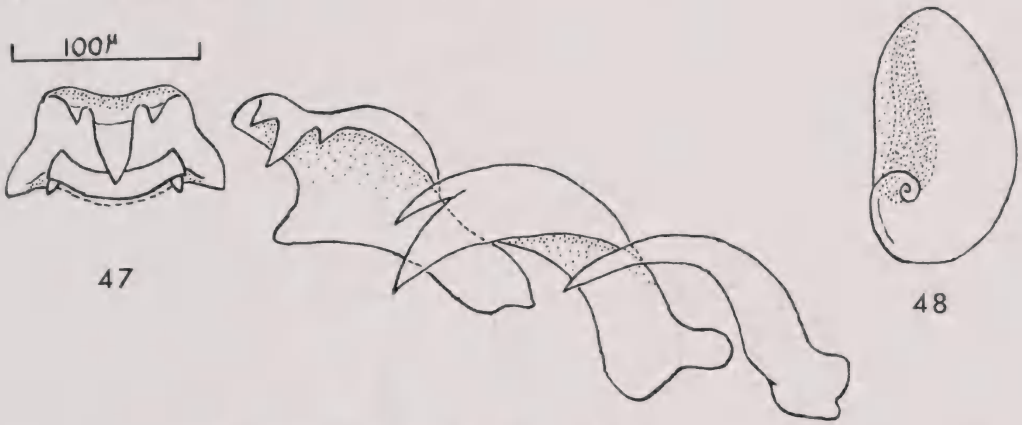


Figs. 45, 46. 45. *Polinices tumidus* (Swainson). 46. *P. flemingiana* (Récluz). Showing orientation of siphonal fasciole in relation to longitudinal axis.

DISTRIBUTION AND ECOLOGY: The species is common throughout the Fiji Islands. In moist sand, on sand-bars and beaches, at high tide level. Fossil record: Walu Bay, Suva, Miocene of Viti Levu (Ladd, 1934).

Ladd (1934), Tinker (1952) and Kaicher (1956) associate the Linnaean *Nerita mamilla* with the common, large and white Indo-Pacific species. Hedley (1924), Rippingale & McMichael (1961), Powell (1965) and Habe & Kosuge (1967), however, consider *Natica pyriformis* to be the appropriate name for the species, *Nerita mamilla* Linnaeus, is in the writer's opinion undefined, and not applicable to the Indo-Pacific species. Linnaeus' cited figures most probably represent the Caribbean *P.lacteus* (Guilding), the Indo-Pacific species *P.tumidus* (Swainson) and *Natica fasciata* (Röding). Linnaeus' original type locality was "Barbados", and this indication would exclude the Indo-Pacific species from consideration; the locality "Alexandriae" was added in 1767, but the species was not any better elucidated. Taxonomic stability would be best served by discarding *Nerita mamilla* as a *nomen dubium.*

Swainson's *Mamillaria tumida* is the earliest name applicable to this species. Swainson's (1840) references to Chemnitz's (1781) figures represent an unequivoval representation of the Indo-Pacific *"Polinices mamilla* auctt." and *Natica pyriformis* Récluz.



Figs. 47, 48. *Polinices tumidus* (Swainson). 47. Half-row radula. 48. Operculum.

Polinices (Polinices) flemingiana (Récluz, 1844) (Figs. 46, 51-53)

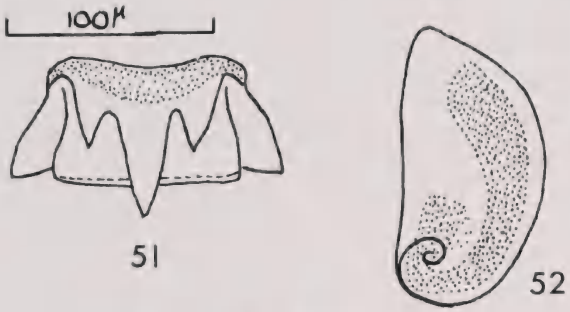
1844. *Natica flemingiana* Récluz, Proc. Zool. Soc. Lond., pt. 11 : 209.
1852. *Natica flemingiana* Récluz, J. Conchyl. 3(2) : 171, pl. 7, figs. 2,3.
1852. *Natica virginea* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 81, pl. 12, fig. 7.
1855. *Natica flemingiana* Récluz, Reeve, Conch. Icon., pl. 18, figs. 80 a,b.
1855. *Natica jukesii* Reeve, Conch. Icon., pl. 19, sp. 84.
1883. *Natica flemingiana* Récluz, Sowerby, Thes. Conchyl. 5 :86, pl. 7, fig. 99.
1924. *Uber flemingianum* Récluz, Hedley, Rec. Aust. Mus. 14(3) : 156.
1956. *Polinices flemingiana* Récluz, Kaicher, Indo-Pacif. sea shells. pl. 1, fig. 5.

Shell similar in size and colour to *P.tumidus* (Swainson) but differs in the following features: aperture elongated obliquely and vertical axis of the shells offset well to left of siphonal fasciole (Fig. 46). A deep anterior umbilical groove present in all adult specimens.

The operculum (Fig. 52) is corneous, light brown in colour, and *in situ* the dark brown zone extends from the nucleus along the labial wall of the operculum. The radula (Fig. 51) is similar to *P.tumidus*, except that the main cusp of the rachidian is longer and the basal shield is higher; the lateral and marginals are basically the same as in *P.tumidus*.

TYPE LOCALITY: Sorsogon, Island of Luzon, Philippines.

DISTRIBUTION AND ECOLOGY: The species is moderately common throughout the Fiji Islands, but is less frequently encountered than *P.tumidus*, although it shares that species habitat.



Figs. 51, 52. *Polinices flemingiana* (Récluz). 51. Rachidian of radula. 52. Operculum.

Polinices (Polinices) aurantius (Röding, 1798) (Figs. 54-56)

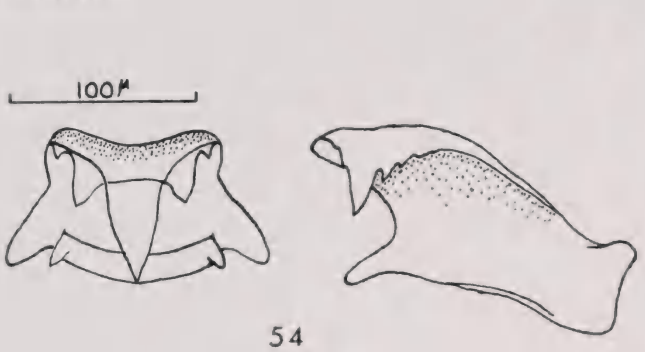
1781. *"Mamma Veneris citrina Chemnitz"*, Syst. Conch. Cab. 5 : 283, pl. 189, figs. 1934-35 *(non binom.)*.
1798. *Albula aurantium* Röding, Mus. Bolten., p. 20 (ref. Chemnitz, *op. cit.*, figs. 1934-35).
1822. *Natica aurantia* Lamarck, Hist. nat. Anim. s. vert. 6 : 198.
1844. *Natica straminea* Récluz, Proc. Zool. Soc. Lond., pt. 11 :211 (publ. in synonymy of *N.aurantia* Lamarck).
1844. *Natica sulphurea* Récluz, Proc. Zool. Soc. Lond., pt. 11 :211 (publ. in synonymy of *N.aurantia* Lamarck).
1852. *Natica straminea* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 113, pl. 16, fig. 3.
1855. *Natica aurantia* Lamarck, Reeve, Conch. Icon., pl. 6, sp. 20 & pl. 9, fig. 32.
1883. *Natica aurantia* Lamarck, Sowerby, Thes. Conchyl. 5 : 85, pl. 2, figs. 15, 16.
1924. *Uber mellosum* Hedley, Rec. Aust. Mus. 14(3) : 158, pl. 22, fig. 5.
1953. *Natica aurantia* Lamarck, Mermod, Rev. suisse Zool. 60 (2) : 178, fig. 182.
1956. *Polinices aurantia* Lamarck, Kaicher, Indo-Pacif. sea-shells, pl. 1, fig. 12.
1966. *Polinices aurantius* (Röding), Habe & Kosuge, Shells world. col. 2 : 35, pl. 12, fig. 10.

Shell similar in general appearance to *P.tumidus* (Swainson), but slightly smaller, less pyriform and more globular; light yellow to orange in colour, apex and umbilical callus white. Aperture slightly narrower than in *P.tumidus*, a thick callus completely fills umbilicus apart from a shallow marginal groove where the callus joins the whorl; this groove tends to be deeper anteriorly. Periostracum orange-brown and opaque.

The operculum is uniformly light orange-brown. The rachidian of the radula (Fig. 54) has 5 cusps in addition to 2 small basal cusps and the lateral has 7 cusps; the inner marginal is bifid and the outer marginal simple.

TYPE LOCALITY: Tranquebar (Chemnitz, 1781).

DISTRIBUTION AND ECOLOGY: The species is rare in the Fiji Islands, and has been recorded only from offshore Islands off the coast of Vitu Levu. In clean coral-sand, intertidal.



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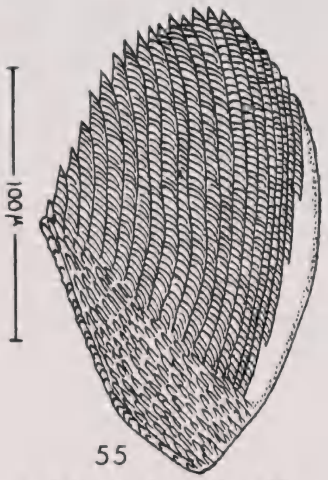

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Figs. 54, 55. *Polinices aurantius* (Röding). 54. Rachidian and lateral of radula. 55. Single jawplate.

Subgenus **Neverita** Risso, 1826

Neverita Risso, 1826, Hist. nat. Eur. mérid. 4 :149. Type species by M. *Neverita josephinia* Risso, 1826. Recent, Mediterranean.

1840. *Mamillaria* Swainson, Treat. Malac., p. 345. Type species by SD (Hedley, 1924) *M.lactea* Swainson, 1840 = *Nerita peselephanti* Link, 1807. Recent. Indo-West Pacific.

Shell moderately large in size, ovate, broad and depressed, smooth and solid, sutures linear; body whorl large, aperture semi-ovate, smooth within. Funicle broad, almost filling umbilicus and connecting with the prominent parietal callus, umbilical groove deep and semi-circular.

The operculum is corneous. The radula is basically similar to *Polinices* s.str.

Polinices (Neverita) albumen (Linnaeus, 1758) (Fig. 57-58)

1758. *Nerita albumen* Linnaeus, Syst. Nat. ed. 10, p. 776 (ref. Rumphius, pl. 22, fig. B only).

1781. *"Vitellus compressus* Chemnitz", Syst. Conch. Cab. 5 : 276, pl. 189, figs. 1924-25 *(non binom.)*.

1855. *Natica albumen* Lamarck, Reeve, Conch. Icon., pl. 8, figs. 31 a,b.

1883. *Natica albumen* Lamarck, Sowerby, Thes. Conchyl. 5 :78, pl. 5, fig. 57.

1956. *Polinices albumen* (Linné), Kaicher, Indo-Pacif. sea-shells, pl. 1, fig. 6.

1966. *Polinices albumen* (Linné), Habe & Kosuge, Shells world col. 2 : 36, pl. 12, fig. 18.

1967. *Polinices (Mammillaria) albumen* (Linné), Habe & Kosuge, Stand. book Jap, shells col. 3 : 48, pl. 18, fig. 28.

Shell moderately large, 25-45 mm in height, ovate, laterally compressed, commencement of aperture about equal with spire; cream or light yellow in colour, spire white. Aperture semi-ovate, funicle broad and almost filling aperture, parietal callus coalescing with funicle, umbilical groove deep and semi-circular, deepest posteriorly.

The operculum is corneous and dark orange-brown in colour.

TYPE LOCALITY: Asiatic Ocean.

DISTRIBUTION AND ECOLOGY: The species is uncommon but occurs in widely scattered localities throughout the Fiji Islands. In clean coral sand on offshore islands.

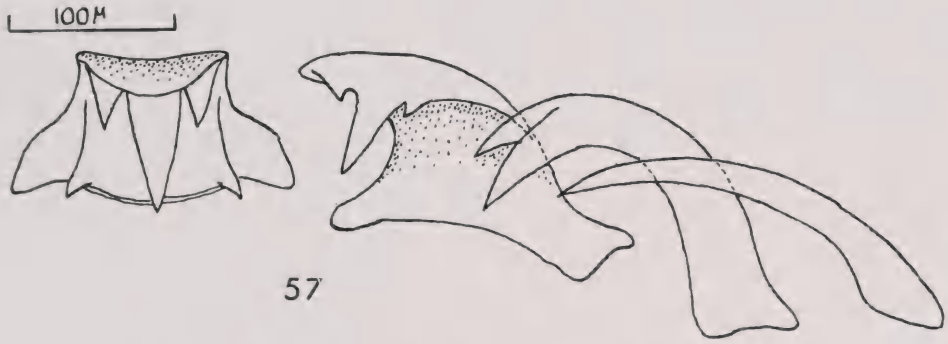


Fig. 57. *Polinices (Neverita) albumen* (Linnaeus). Half-row of radula.

Subgenus **Mammilla** Schumacher, 1817

Mammilla Schumacher, 1817, Ess. nouv. syst., pp. 58, 190. Type species by M *Mammilla fasciata* Schumacher, 1817 = *Albula mammata* Röding, 1798. Recent, Western Pacific.

1840. *Naticaria* Swainson, Treat. Malac., p. 346. Type species by SD (Hedley, 1924) *Naticaria melanostoma* Martini = *Nerita melanostoma* Gmelin, 1791. Recent, Indo-Pacific.

1847. *Ruma "Chem."*, Gray, Proc. Zool. Soc. Lond., p. 149. Type species by OD *Natica maura* = *Natica maura* Lamarck, 1816. Recent, Indo-Pacific.

1851. *Reuma* "Chemnitz", Récluz, J. Conchyl. 2(2) : 197 *(nom. null.)*.

Shell small to moderate in size, thin and inflated, smooth or sculptured with fine spiral striae; whorls small, separated by adpressed sutures, body whorl large. Aperture semi-ovate to elliptical, smooth within, parietal callus narrow, partly overlapping umbilicus, funicle indistinct.

The operculum is corneous.

Species of the subgenus differ from *Polinices s.str.* in having thinner, less solid shells, a somewhat wider aperture and a moderately narrow parietal callus.

Polinices (Mammilla) maurus (Lamarck, 1816) (Figs. 59-61)

1816. *Natica maura* Lamarck, Tabl. Encycl. Méth., p. 10, pl. 453, figs. 4a,b.

1822. *Natica melanostoma* var. b. Lamarck, Anim. s. vert. 6 : 198.

1852. *Natica maura* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 58, pl. 9, fig. 6.

1855. *Natica maura* Bruguière, Reeve, Conch. Icon., p. 7, figs. 25 a,b.

1883. *Natica maura* Bruguière, Sowerby, Thes. Conchyl. 5 : 98, pl. 3, fig. 36.

1913. *Polinices nuxcastanea* "Martyn", Hedley, Proc. Linn. Soc. N.S.W. 38 (2) : 301 (ref. Martyn, 1786, pl. 106).

1924. *Uber nuxcastaneum* "Martyn", Hedley, Rec. Aust. Mus. 14(3) : 159.

1953. *Natica melanostoma* var. b Lamarck, Mermod, Rev. suisse Zool. 60(2) : 178, fig. 181(4) (figd. type).

1956. *Polinices maura* Bruguière, Kaicher, Indo-Pacif. sea-shells, pl. 1, fig. 8.

1966. *Mammilla maura* (Bruguière), Habe & Kosuge, Shells world col. 2 :35, pl. 12, fig. 12.

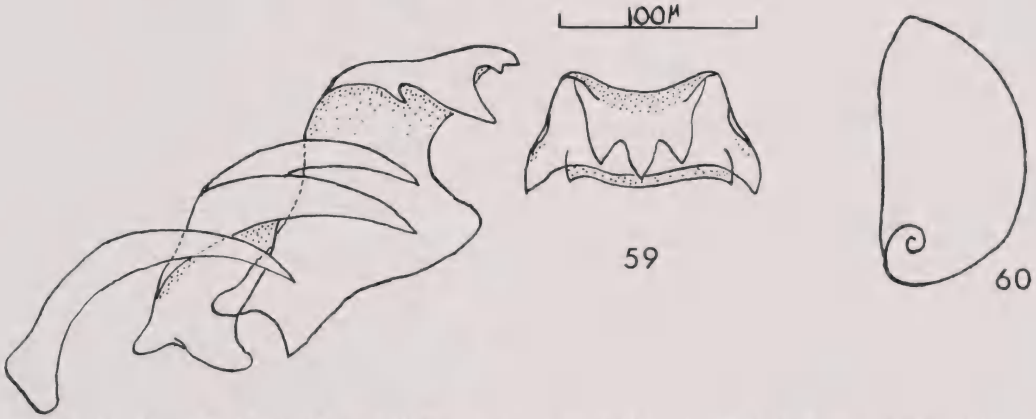
Shell moderately large, 20-50mm in height, pyriformly ovate, light in weight, smooth apart from fine, close-set growth striate; dull in texture, tan or dark brown in colour, apex white. Aperture semi-ovate, wide, parietal callus dark brown and folded over umbilicus without completely covering the deep umbilical groove. Periostracum brown in colour and moderately opaque.

The operculum (Fig. 60) is corneous and dark reddish-brown. The radula (Fig. 59) is similar to *Polinices tumidus* (Swainson).

TYPE LOCALITY: Indian Ocean (Lamarck, 1822).

DISTRIBUTION AND ECOLOGY: The species is moderately common throughout the Fiji Islands. In weedy coral-sand, but more commonly found in muddy-sand localities, intertidal.

Several authors have credited Bruguière with the authorship of *P.maurus,* and one author gives 1792 as the year of description. The species was described by Lamarck in the "Tableau Encyclopédique et Méthodique", which was published in 1816, several years after Bruguière's death.



Figs. 59, 60. *Polinices (Mammilla) maurus* (Lamarck). 59. Half-row of radula. 60. Operculum.

Polinices (Mammilla) melanostomus (Gmelin, 1791) (Figs. 62-65)

1781. *"Mamma aethiopissae* Chemnitz", Syst. Conch. Cab. 5 : 278, pl. 189, figs. 1926-27 *(non binom.).*

1791. *Nerita melanostoma* Gmelin, Syst. Nat. ed. 13, p. 3674 (ref. Lister, pl. 566, fig. 15 & Chemnitz, *op. cit.,* figs. 1926-27).

1851. *Natica opaca* Récluz, J. Conchyl. 2(2) : 199.

1852. *Mamilla putamen* Mörch, Cat. Conchyl. Com. Yoldi 1 : 132 (ref. Lister, pl. 566, fig. 15).

1852. *Natica melanostoma var. lactea* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 31 (non *Naticina lactea* Guilding, 1834).

1852. *Natica melanostoma* var. *subfasciata* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 31 (non d'Orbigny, 1850).

1852. *Natica melanostoma* var. *zonata* Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 31, pl. 4, figs. 15,16.

1855. *Natica melanostoma* Gmelin, Reeve, Conch. Icon., pl. 8, figs. 30 a,b.

1855. *Natica succineoides* Reeve, Conch. Icon. pl. 17, figs. 73 a,b.

1924. *Uber opacum* Récluz, Hedley, Rec. Aust. Mus. 14(3) : 159, pl. 22, fig. 3.

1953. *Natica melanostoma* Lamarck, Mermod, Rev. suisse Zool. 60(2) : 176, fig. 1/3).

1956. *Polinices melanostoma* Gmelin, Kaicher, Indo-Pacif. sea-shells, pl. 1, fig. 7.

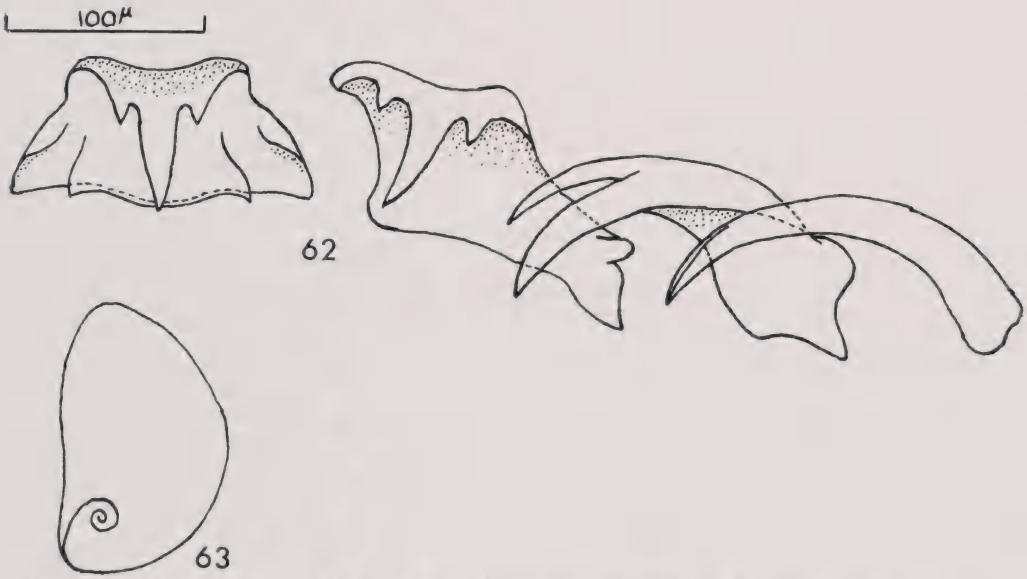
1967. *Mammilla opaca* (Récluz), Habe & Kosuge, Stand. book Jap. shells col. 3 :45, pl. 18, fig. 1.

Shell moderately large, 25-55mm in height, similar to *P.maurus* in shape but more solid; surface shining and ornamented with close-set growth lines and obsolete macroscopic spirals. White or steel-grey in colour, ornamented with 3 brownish-grey bands on body whorl; in some specimens these zones broken up into irregular spots or blotches. Aperture semi-ovate, wide, white or light brown within. Parietal callus dark brown and folded over umbilicus without completely covering it; a prominent, curved dark brown zone extending from centre of umbilicus to base.

The operculum (Fig. 63) is corneous, dark reddish-brown in colour and similar to the operculum of *P.maurus* (Gmelin). The rachidian of the radula (Fig. 62) has a central cusp which is longer than in *P.maurus* and the accessory side-cusps are set much higher.

TYPE LOCALITY: Indian Seas.

DISTRIBUTION AND ECOLOGY: The species is moderately common throughout the Fiji Islands. In clean coral or weedy sand of offshore islands. Fossil record: Coast of Ravuka, Late Pleistocene (Ladd,1934).



Figs. 62, 63. *Polinices (Mammilla) melanostomus* (Gmelin). 62. Half-row of radula. 63. Operculum.

Gmelin's reference to figures 1926-27 in Chemnitz (1781) are the most appropriate citations for the species. The Lister figure 36 and Born's *Helix mamillaris* (non Linnaeus) appear to be the related species *P.(M.)sebae* (Récluz, 1844).

Polinices (Mammilla) melanostomoides (Quoy & Gaimard, 1833) (Figs. 66-67)

1833. *Natica melanostomoides* Quoy & Gaimard, Voy. Astrolabe 2 :229, pl. 66, figs. 4-8.
1852. *Natica melanostomoides* Quoy & Gaimard, Philippi, Syst. Conch. Cab., 2nd ed. 2(1) : 58, pl. 9, fig. 5.
1855. *Natica melanostomoides* Quoy & Gaimard, Reeve, Conch. Icon., pl. 22, sp. 101.
1883. *Natica melanostomoides* Quoy, Sowerby, Thes. Conchyl. 5 :97, pl. 6, fig. 78.
1924. *Uber melanostomoides* Quoy & Gaimard, Hedley, Rec. Aust. Mus. 14(3) : 158.
1966. *Mammilla sebae* (Récluz), Habe & Kosuge, Shells world col. 2 :121, pl. 45, fig. 14 (non *Natica sebae* Récluz, 1844).

Shell moderately small, 20-25mm in height, fragile, irregularly pyriform, laterally slightly compressed, spire short; white in colour, ornamented with 3 spiral rows of irregular, dark brown spots. Aperture wide, ear-shaped, columella concavely excavated, parietal callus dark brown, narrow, and folded over the umbilicus leaving a narrow groove; anterior edge of columella stained dark brown.

TYPE LOCALITY: New Guinea and New Ireland.

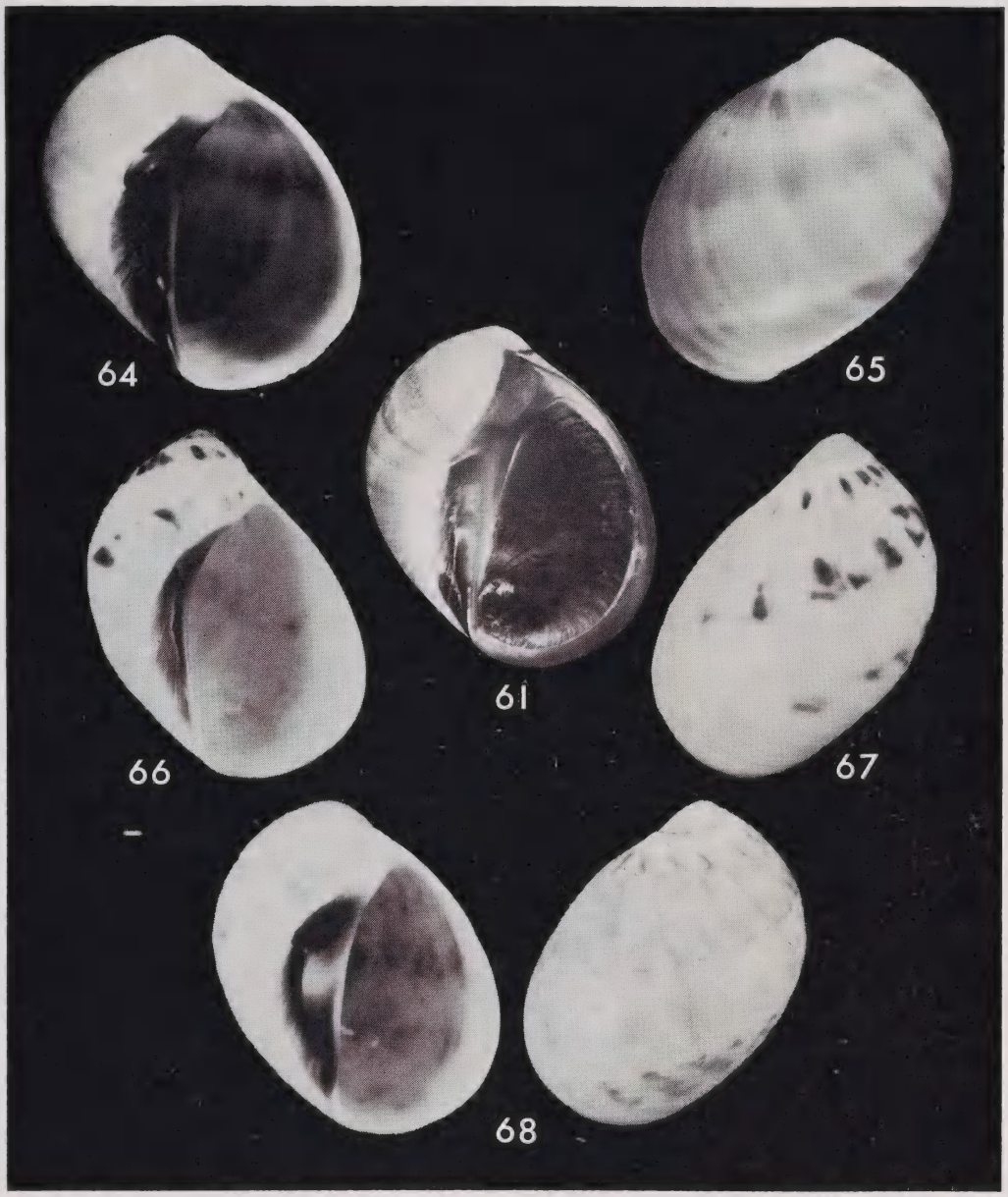
DISTRIBUTION AND ECOLOGY: The species is rare in the Fiji Islands, and all specimens collected were found devoid of animal; the species has been recorded from Manava I., off the coast of Nth. Viti Levu. In coral sand.

Polinices (Mammilla) simiae (Deshayes in Deshayes & Edwards, 1838) (Fig. 68)

1781. *"Ruma simiae* Chemnitz" Syst. Conch. Cab. 5 : 285, pl. 189, fig. 1938 *(nom binom.).*
1828. *Natica sigaretina* Menke, Synop. meth. Moll., p. 26 (ref. Chemnitz, *op. cit.*, fig. 1938) [non J. de C. Sowerby, 1824].
1834. *Natica simiae* Deshayes in Deshayes & Edwards, Hist. nat. anima. s. vert., ed. 2,2 : 522 (ref. Chemnitz, *op cit.*, fig. 1938).
1844. *Natica samarensis* Récluz, Proc. Zool. Soc. Lond., pt. 11 :214.
1852. *Natica simiae* Deshayes, Philippi, Syst. Conch. Cab. 2nd ed. 2(1) : 35, pl. 4, fig. 17.
1855. *Natica simiae* Chemnitz, Reeve, Conch. Icon., pl. 17, figs. 76a, b.
1883. *Natica simiae* Chemnitz, Sowerby, Thes. Conchyl. 5 :97, pl. 6, fig. 71.
1924. *Uber simiae* Deshayes, Hedley, Rec. Aust. Mus. 14(3) : 162, pl. 22, fig. 2.
1929. *Mammilla propesimiae* Iredale, Aust. Zool., 5(4) : 341, pl. 38, fig. 5 (figure only, description lacking).
1934. *Polinices simiae* (Deshayes), Powell, Trans. Proc. R.Soc. N.Z. 64(2) : 156.
1967. *Mammilla simiae* (Deshayes), Habe & Kosuge. Stand. book Jap. shell col. 3 :45, pl. 18, fig. 2.

Shell small, 10-20 mm in height, similar in form to *P.(M.)melanostoma*, but more fragile. White or cream in colour, ornamented with a broad, brownish zone adjacent to suture containing irregular maculations and dots; a narrow zone of streak-like markings situated at base and centre part of body whorl irregularly marbled in a lighter colour. Parietal callus dark brown and thicker than in *P.(M.)melanostoma;* umbilicus and anterior edge of columella stained with brown.

TYPE LOCALITY: New Zealand.



Figs. 61, 64-68. 61. *Polinices (Mammilla) maurus* (Lamarck). Manava I., Fiji I.; height 39.0mm. 64, 65. *P. (M.) melanostomus* (Gmelin). Manava I., Fiji I.; height 29.7mm. 66, 67. *P. (M.) melanostomoides* (Quoy & Gaimard). Manava I., Fiji I.; height 24.7mm. 68. *P. (M.) simiae* (Deshayes in Deshayes & Edwards). Malolo Barrier reef, Mamanuca group, Fiji I.; height 22.5mm.

DISTRIBUTION: The species is rare in the Fiji Islands and specimens collected were found devoid of animal on sandy lagoons off the west coast of Viti Levu.

Deshayes & Edwards (1838) gave New Zealand as the type locality, and attributed the indication to Chemnitz. Chemnitz's specimens, however, came from

the Nicobar Islands, and it was Chemnitz (1781) who credited d'Argenville with the New Zealand locality. The species is widely distributed throughout the Pacific, and is less rare in the Hawaiian and Kermadec Islands. The species does occur in New Zealand but is confined to the northern part of the North Island.

Subfamily SININAE Woodring, 1928

Genus **Eunaticina** Fischer, 1885

Eunaticina Fischer, 1885, Man. Conchyl., p. 768. Type species (art. 67i of ICZN) *Naticina papilla* (Gmelin) = *Nerita papilla* Gmelin, 1791. Recent, Western Pacific. *(Nom. subst. pro Naticina* Gray, 1847).

1840. *Naticina* Gray, Synop. Brit. Mus., ed. 40, pl. 147 *(nom. nud.)*.

1847. *Naticina* Gray, Proc. Zool. Soc. Lond., pl. 150. Type species by OD *N.papilla* (Gmelin) (non *Naticina* Guilding, 1834).

Shell small to moderate in size, thin and inflated, spire low, body whorl large, sculptured with spiral grooves; aperture semi-ovate but wide, umbilicus deep and axially elongate, parietal callus moderately prominent and partly covering umbilicus, anterior parietal callus narrow and partly folded over edge of umbilicus.

The animal is very large and is unable to withdraw completely into the shell. The operculum is small and corneous.

Eunaticina is a group intermediate between *Mammilla* Schumacher and *Sinum* Röding.

Eunaticina papilla (Gmelin, 1791) (Fig. 69)

1781. *"Papilla seu Ruma felis* Chemnitz", Syst. Conch. Cab. 5 : 285, pl. 189, fig. 1939 *(non binom.)*.

1791. *Nerita papilla* Gmelin, Syst. Nat., ed. 13, p. 3675 (ref. Chemnitz, *op. cit.*, fig. 1939).

1798. *Albula tranquebarica* Röding, Mus. Bolten., p. 21 (ref. Chemnitz, *op. cit.*, fig. 1939).

1833. *Natica costulata* Quoy & Gaimard, Voy. Astrolabe 2 :235, pl. 66, figs. 20, 21.

1840. *Naticaria cancellata* Swainson, Treat. Malac., p. 346 (ref. Chemnitz, *op. cit.*, fig. 1939).

1874. *Naticina papilla* "Chemnitz", Souverbie & Montrouzier, J. Conchyl. 22 :198, pl. 7, fig. 8 (operculum).

1956. *Sinum papilla* Gmelin, Kaicher, Indo-Pacif. sea-shells, pl. 2, fig. 8.

Shell moderately small, 15-25 mm in height, thin, pyriformly-ovate, body whorl suture deep; white in colour under a thin light brown periostracum. Sculptured with *c.*40-60 spiral grooves and bisected by close-set, fine axial growth lines; in some specimens spiral grooves wide-spaced in others close-set. Parietal callus narrow, folded over umbilicus posteriorly and continuing on columellar wall to base; umbilicus open and deep.

The operculum is corneous, light brown in colour and translucent (*fide* Souverbie & Montrouzier, 1874).

TYPE LOCALITY: Tranquebar.

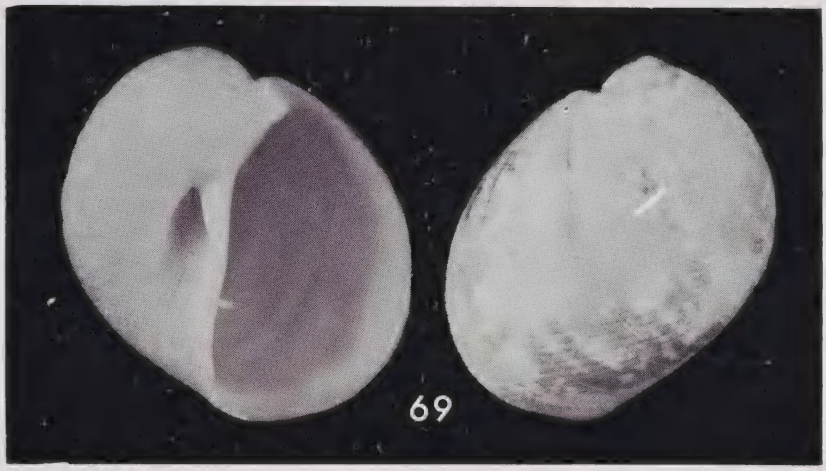


Fig. 69. *Eunaticina papilla* (Gmelin). Tavutha reef, near Vatia wharf, Fiji I.; height 22.5mm.

DISTRIBUTION AND ECOLOGY: The species is uncommon in the Fiji Islands, and has been recorded from the north, west and south coasts of Viti Levu. Below low tide level in weedy sand.

FOSSIL SPECIES

Subfamily GLOBULARINAE WENZ, 1941

Genus **Globularia** Swainson, 1840

Globularia Swainson, 1840, Treat. Malac., p. 345. Type species by SD (Herrmannsen, 1847) *Natica sigaretina* Lamarck = *Ampullaria sigaretina* Lamarck, 1804. Eocene of Paris Basin.

Globularia (Waluia) edwardsi Ladd, 1934

1934. *Globularia (Waluia) edwardsi* Ladd, Bern. P. Bish. Mus. Bull. 119 :212, pl. 36, figs. 7,8 & pl. 37, figs. 1, 2 & pl. 38, fig. 1.

TYPE LOCALITY: Quarry south side Walu Bay, Miocene of Viti Levu.

This species is the type species of the subgenus *Waluia* Ladd, 1934, which differs from *Globularia* s.str. in the wide and flaring aperture.

Globularia (Cernina) fijiensis Ladd & Hoffmeister, 1945

1945. *Globularia (Cernina) fijiensis* Ladd & Hoffmeister, Bern. P. Bish. Mus. Bull. 181 : 358, pl. 51, figs. A, B.

TYPE LOCALITY: Coast between Tubou and Tarakua-wai, Miocene of Lakeba, Lau Islands.

Genus **Pachycrommium** Woodring, 1928

Pachycrommium Woodring, 1928, Carnegie Inst. Washington Pub. 385 : 391. Type species by OD *Amaura guppyi* Gabb. Miocene, Dominican Republic.

Pachycrommium stockwelli Ladd & Hoffmeister, 1945

1945. *Pachycrommium stockwelli* Ladd & Hoffmeister, Bern. P. Bish. Mus. Bull. 181 : 359, pl. 51, figs. C, D.

TYPE LOCALITY: Tip of Dukelulu Point, Miocene of Vanua Balavu, Lau Islands.

Pachycrommium ? pacificum Ladd & Hoffmeister, 1945

1945. *Pachycrommium ? pacificum* Ladd & Hoffmeister, Bern. P. Bish. Mus. Bull. 181 : 359, pl. 51, figs. E, F.

TYPE LOCALITY: Western end of western lake, Miocene of Oneata, Lau Islands.

Subfamily SININAE *Woodring*, 1928

Genus **Sinum** Röding, 1798

Sinum Röding, 1798, Mus. Bolten., p. 14. Type species by SD (Dall, 1915) *Sinum haliotoideum* Röding, 1798 = *Helix haliotoidea* Linnaeus, 1758. Recent, ? Western Pacific.

Sinum lekalekanum Ladd & Hoffmeister, 1945

1945. *Sinum lekalekanum* Ladd & Hoffmeister, Bern. P. Bish. Mus. Bull. 181 : 357, pl. 50, figs. O, P.

TYPE LOCALITY: Dukelulu Point, Miocene of Vanua Balavu, Lau Islands.

NOTES ON NATICID NOMENCLATURE

Natica zebra Lamarck, 1822 (figd. Abbott, 1962, p.50 and Habe & Kosuge, 1966, pl. 12, fig. 13): the prior name for this species is *Cochlis undulata* Röding, 1798 (ref. Chemnitz, 1781, pl. 187, figs. 1885-86).

Notocochlis lineata Gmelin, 1791 (cited by Habe & Igarashi, 1967 and figured by Habe & Kosuge, 1966, pl. 12, fig. 12): the author of *Cochlis lineata* is Röding, 1798. *Nerita lineata* Gmelin,1791 is a species of Neritidae.

Natica maculosa Lamarck, 1822 (figd. Abbot, 1962, p.50): the prior name is *Cochlis tigrina* Röding, 1798, Mus. Bolten., p. 147 (ref. Chemnitz, 1781, pl. 187, fig. 1892). Other synonyms are *Natica maculata* Perry, 1811 (non *Nerita maculata* v.Salis, 1793), *Natica javana* Lamarck, 1822 and *N.pellistigrina* Dunker, 1882 & auctt..

Natica alba Gray, 1827 (non *Polinices albus* Montfort, 1810) [figd. Rippingale & McMichael, 1961, pl. 11, fig. 3): the prior name is *Nerita peselephanti* Link, 1807 (ref. Chemnitz, 1781, pl. 190, figs. 1922-23). Other synonyms are *Natica peselephantis* Deshayes in Deshayes & Edwards,1838 and *Mamillaria lactea* Swainson, 1840.

Natica millepunctata Lamarck 1822 (figd. Nordsieck, 1968, pl. 16, fig. 63-10) : the prior name is *Nerita stercusmuscarum* Gmelin, 1791 (ref. Chemnitz, 1781, pl. 187, fig. 1894). Other synonyms are *Cochlis milleporia* Röding, 1798 and *Natica guttata* Link, 1807.

Nerita cruentata Gmelin,1791 (considered by some authors to be a variant of *N.stercusmuscarum* Gmelin; figd. Nordsieck, 1968, pl. 17, fig. 63-12 as *Naticarius maculatus* v. Salis). Synonyms of the species are *Nerita maculata* v. Salis, 1793, *Cochlis fanel* Röding,1798, *C.stercusmuscarum* Röding,1798, *Natica maculata* Sowerby, 1825, *N.adspersa* Menke, 1829, *N.fanel* Récluz, 1844 and *Nerita hebraea* auctt.

Natica orientalis (Gmelin,1791): synonyms of the species are *Albula vitellus* Röding, 1798 (non *Nerita vitellus* Linnaeus, 1758), *Cochlis explanata* Röding, 1798, *Natica eburnea* Deshayes in Deshayes & Edwards, 1838 and *N.eburnea* Philippi,1852.

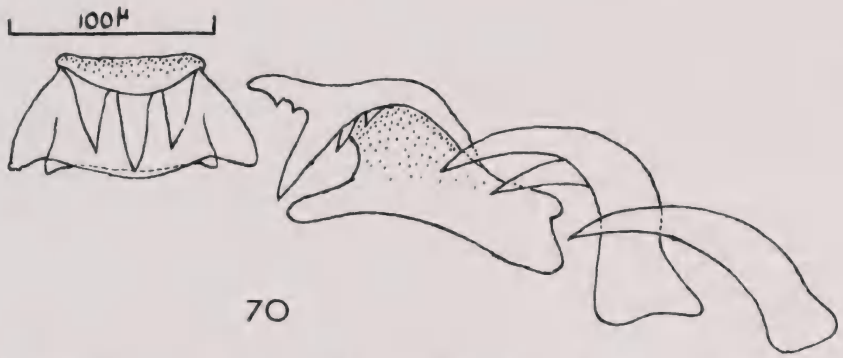


Fig. 70. *Natica chemnitzii* Pfeiffer. San Carlos Bay, Guaymas, Mexico; half-row of radula.

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NEW ZEALAND MOLLUSCAN SYSTEMATICS WITH DESCRIPTIONS OF NEW SPECIES: PART 7

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Abstract. In this part sixteen species are added to the New Zealand Recent fauna, and of these, eight are either new species or new subspecies, and seven are representative of genera not recorded previously from the Recent fauna of these seas — they are *Cantharus, Claraxis, Gegania, Latiaxis, Pictobalcis, Terebra* and *Volva.*

The Pleistocene muricid, *Pterynotus zealandicus* (Hutton), previously considered extinct, is now known to occur living in shallow water, both at the Poor Knights Islands and at Whangaruru, and the record by Hedley (1916) of a Kerguelen species, *Trophon albolabratus* (E. A. Smith) from Macquarie Island is confirmed.

Family PLANAXIDAE

Genus **Hinea** Gray, 1847

Type-species (monotypy) *Planaxis mollis* Sowerby = *Buccinum brasilianum* Lamarck, 1822.

Hinea brasiliana (Lamarck, 1822)

1822. *Buccinum brasilianum* Lamarck, Hist. Anim. s. Vert. 7 : 272.

1823. *Planaxis mollis* Sowerby, Gen. Shells 2, pl. 208, fig. 2.

1913. *Planaxis (Hinea) brazilianus :* Suter, Man. N.Z. Moll. : 194.

1927. *Planaxis brazilianus :* Finlay, Trans. Proc. N.Z. Inst. 57 : 376.

1952. *Hinea braziliana* : Powell, Rec. Auckland Inst. Mus. 4 (3) : 174.

Suter (1913) admitted this species to the New Zealand fauna, citing Bay of Islands as locality but with no authority, and Finlay (1927) rejected the record for lack of more positive evidence of New Zealand occurrences. However, in these "Records" (1952), the writer recorded a dead shell from the Great Barrier Island, and another, a living example, taken at Whangaroa in 1924. The writer can now report the establishment of the species, in large numbers, in a small bay on the Rangiawhia Peninsula, Northland east coast. This colony was discovered by Mr Michael Spencer of Whangarei in December 1968.

Family MATHILDIDAE

Genus **Gegania** Jeffreys, 1884

Type (monotypy) *G. pinguis* Jeffreys, 1884 (= *Tuba* Lea, 1833, non Fabricius, 1822).

The species described below, adds a genus and species to the New Zealand Recent fauna, but a similar shell, of the subgenus *Tubena* Marwick, 1943, is known from the Awamoan lower Miocene of Allday Bay, near Oamaru. The type species of *Gegania,* which is from 816-1230 fathoms (1126-2249 metres) off Galway Bay, Ireland, is of similar appearance to the New Zealand Recent shell, but is smaller, only 8.5 mm in height, has fewer, wider spaced spirals, and is crossed by numerous axial threads, that are more prominent in the interspaces. Marwick's subgenus *Tubena* differs from the typical genus in being umbilicated.

Gegania valkyrie sp.n (Fig. 1)

Shell rather broadly conical, thin, white, with gently rounded whorls, broadly and weakly angulated at the periphery of the body-whorl. Aperture squarish, with a thin outer-lip, and a straight vertical pillar, with a thin broadly reflected outer edge, slightly effuse below. Protoconch small, planorbid, of about one whorl, that is strongly tilted. Post-nuclear whorls delicately sculptured with spiral cords; at first with 4 narrow cords above a weak angulation at less than one third whorl height, and 2 stronger cords below it, increased by interpolation, to 8 above and 4 below the angulation, on the penultimate. The whole surface is crossed by numerous fine axial threads that weakly crenulate the spirals, and stronger corded sculpture continues over the base, which is imperforate.

Height 14.25mm, width 9.0 mm.

Locality: E.S.E. of the Poor Knights Islands, 329m.

Holotype: presented to the Auckland Museum by Mr C. Wormald.

The species is named after the trawler M.V. 'Valkyrie', which was engaged in the prawn survey of 1969, from which source, this and other species attributed to Mr Wormald were obtained.

Family ARCHITECTONICIDAE

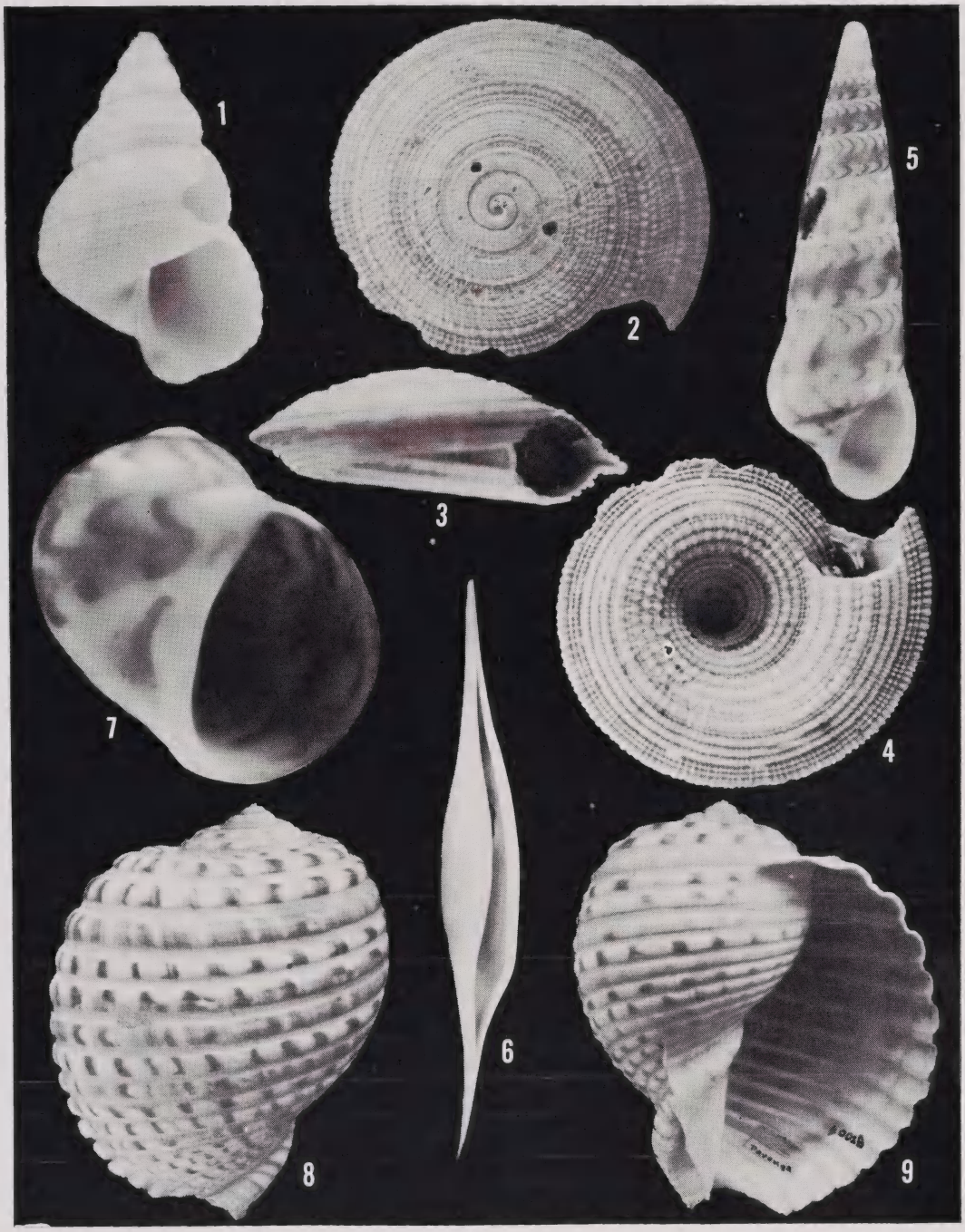
Genus **Philippia** Gray, 1847

Subgenus **Psilaxis** Woodring, 1928

Type-species (OD) *Architectonica (Philippia) krebsii* Mörch.

Philippia (Psilaxis) oxytropis A. Adams, 1855

1855. *Philippia oxytropis* A. Adams, Proc. Zool. Soc. Lond.: 317.
1863. *Solarium (Philippia) oxytropis:* Hanley, Thes. Conch. 3:236, pl. 253, figs. 46,47.
1931. *Philippia manifesta* Iredale, Rec. Aust. Mus. 18:229,235, pl. 25, figs. 9,10.
1938. *Philippia manifesta:* Powell, Rec. Auckland Inst. Mus. (3), 168.
1970. *Philippia (Psilaxis) oxytropis:* Robertson, Pacif. Sci. 24(1): 66-83.



Figs. 1-9. 1. *Gegania valkyrie* Powell, sp. n. Holotype, Auck. Inst. Mus., 14.25 x 9.0mm, off Poor Knights Islands, 329m. 2, 3, 4. *Claraxis* cf. *illustris* Iredale, off Mayor Island, 82m, 3.75 x 9.1mm. 5. *Balcis (Pictobalcis) articulata* (Sowerby), near Bland Bay, Northland, 26.0 x 8.0mm. 6. *Volva (Phenacovolva) longirostrata* (Sowerby), Poor Knights Islands, 46m, 62.5 x 7.5mm. 7. *Notocochlis sagittata hancockae* Powell, subsp. n., Holotype, Auck. Inst. Mus., 11.8 x 11.9mm, Urupukapuka Island, Bay of Islands. 8, 9. *Tonna luteostoma* (Küster, 1857), coast south of Parengarenga Harbour, 98.5 x 84.0mm.

The type locality for *oxytropis* is New Caledonia, and that for *manifesta* is Sydney Harbour, New South Wales.

Robertson (1970,loc.cit.) recognised two closely allied Indo-Pacific species, *radiata* (Röding, 1798) and *oxytropis* A. Adams, 1855, citing as the main distinguishing character, the size of the protoconch, which was stated to be the larger in *oxytropis*. Both species were recorded from New Zealand, by Robertson, on the basis of shells from Takou Bay, Northland east coast.

However, examination of series from this same locality shows both extremes in protoconch size, plus others of intermediate sizes, making it impossible to consider the Takou shells to represent more than one species. Adams' *oxytropis* is selected as the more applicable name for the New Zealand shells, since the colour pattern lacks radiate triangular extensions of the subsutural colour band, which is the characteristic pattern in *radiata*.

Genus **Claraxis** Iredale, 1936

Type-species (OD) *Claraxis illustris* Iredale, 1936

The shell recorded below adds a genus and a species to the New Zealand Recent fauna. The type species comes from 45 fm (82 m) off Crowdy Head, near Manning River, New South Wales, and the New Zealand examples, respectively, are from off the south end of Mayor Island, Bay of Plenty in 82 m, and between Mokohinau Island and Hen Island in 101 m.

Claraxis cf. **illustris** Iredale, 1936 (Figs. 2-4)

1936. *Claraxis illustris* Iredale, Rec. Aust. Mus. 19(5): 327.

Shell depressed, lenticular with a sharp and strongly projecting, crenulated peripheral keel, that is hollow internally. Suture narrow but deeply channelled. Post-nuclear dorsal surface covered by dense, delicately beaded, spiral lirae, and two widely spaced stronger spirals, with a third forming the single peripheral keel. Ventral surface with a wide umbilical cavity, more than one third the width of the shell; the whole densely sculptured with beaded cords, those within the umbilicus the stronger.

Height 3.75 mm, width 9.1 mm. Off Mayor Island, 82 m.

Height 4.00 mm, width 8.5 mm holotype, N.S.W., 82 m.

Height 6.75 mm, width 13.0 mm. Off Jibbon, N.S.W., 85 m.

Neither the holotype nor the New Zealand examples are fully grown, but one from 85 m off Jibbon, New South Wales, with a diameter of 13 mm appears to be the adult of the species. If this surmise is correct, then upon maturity, the spire becomes relatively higher and the umbilical cavity constricted to steep-sided over its last volution.

A second member of the genus is *Solarium asperum* Hinds, 1844, from Straits of Macassar.

Family EULIMIDAE

Genus **Balcis** Leach, 1847

Subgenus **Pictobalcis** Laseron, 1955

Type-species (OD) Eulima articulata Sowerby, 1834.

Balcis (Pictobalcis) articulata (Sowerby, 1834) (Fig. 5)

1834. *Eulima articulata* Sowerby, Proc. Zool. Soc. Lond.: 8.
1886. *Eulima articulata:* Tryon, Man. Conch. 8: 269, pl. 68, fig. 12.
1955. *Pictobalcis articulata:* Laseron, Aust. Zool. 12 (2): 98, pl. 3, fig. 12.

This species can now be added to the New Zealand fauna, on the basis of several shells, in fairly fresh condition, found by Mrs. J. Waldron of Whangarei, washed ashore on several occasions, in rocky bays along the Northland east coast. The subgenus differs from *Balcis*, a plain porcellanous-white shell, in having an intricate colour pattern.

Shell very large for the family, solid, narrow, with a very tall, many whorled spire, of straight outlines; body-whorl bluntly rounded at the periphery. Surface smooth and highly polished, interrupted at about two-third whorl intervals, by broad flattened varices. Colour opaque porcellanous-white, strikingly maculated, the basic pattern consisting of a central band of chestnut, from which narrow chevrons extend, top and bottom, almost to the sutures; in front of each varix there is a diffused vertical stripe of purplish-brown, and a second band of chestnut, also with chevrons, encircles the lower base; interior of aperture white, with the external pattern showing through.

Height 26.0 mm, width 8.0 mm. Near Bland Bay, Northland.

Height 23.0 mm, width — . Australia; type.

Height 21.0 mm, width 5.8 mm. Shellharbour, New South Wales.

Localities: Australia (type; probably Moreton Bay; Shellharbour, New South Wales (Laseron); New Zealand, coast between Bland Bay and Whangamumu (Mrs J. Waldron).

Genus **Venustilifer** Powell, 1939

Type-species (OD) *Hypermastus bountyensis* Powell, 1933

Venustilifer bountyensis (Powell, 1933)

1933. *Hypermastus bountyensis* Powell, Proc. Malac. Soc. 20(5): 235.
1939. *Venustilifer bountyensis:* Powell, Rec. Auckland Inst. Mus. 2(4): 234.
1940. *Venustilifer secundus* Powell, Trans. Proc. R. Soc. N.Z. 70(1): 235.

This genus, which was thought to belong to the Stiliferidae, now proves to have more in common with the eulimid genus *Mucronalia*.

Two specimens, taken alive from the test of a cidarid echinoid in 329 m, E.S.E. of Poor Knights Islands, prove the genus to be ectoparasitic, like some species of *Balcis* and *Mucronalia*. Although there is a small fleshy frill at the base

of the proboscis, it is rudimentary, compared with that of *Stilifer,* a truly parasitic mollusc, that becomes deeply embedded in the body of its host, with only the protoconch protruding. It was noted by Mr. C. Wormald, who collected the Poor Knights specimens, that they were free living, nestling on the test of the echinoid, and were easily picked off.

It appears that the Poor Knights examples represent the adult of a somewhat variable species, that includes the narrower *secundus* form within its range. Hitherto all the material has been immature, white, semitransparent, empty shells. The Poor Knights examples show the species to be of much larger size than the respective types of *bountyensis* and *secundus,* and to possess a striking colour pattern, consisting of broad spiral zones of dark reddish-brown on a whitish semi-transparent ground; a narrow white line submargins the suture, followed by a wide dark zone, then a white zone of similar width, extending to a little below middle whorl height; from there to a little below the lower suture is a second dark zone, followed by a light brown base to the columella, which is white, bordered on each side by a dark-brown line. The peg-like protoconch is always tilted and partly immersed to a varying degree. The genus *Mucronalia* differs in having the peg-like protoconch always erect, and with more numerous post-nuclear whorls, that assume an elongate-cylindrical form.

Height 3.40 mm, width 2.60 mm. Off Poor Knights, 329 m.

Height 1.84 mm, width 1.34 mm. Off Bounty Islands; type of *bountyensis.*

Height 1.65 mm, width 1.28 mm. Off Three Kings Islands; type of *secundus.*

Family OVULIDAE

Genus **Volva** Röding, 1798

Subgenus **Phenacovolva** Iredale, 1930

Type-species (OD) *P.nectarea* Iredale, 1930 = *Bulla birostris* Linnaeus, 1767.

Volva (Phenacovolva) longirostrata (Sowerby, 1828) (Fig. 6)

1828. *Ovulum longirostratum* G. B. Sowerby, Zool. Journ. 4(14) : 160.

1932. *Volva birostris* (non Linnaeus, 1767) : Schilder, Proc. Malac. Soc. Lond. 20(1) : 56.

This record adds a family, genus and species to the New Zealand Recent fauna. The material was found by Mr T. Ayling of Auckland in May, 1969, at the Poor Knights Islands, where the species was obtained living on gorgonians, at a depth of 150 feet (46 m).

Shell moderately large, the body long and narrow, greatly produced at the extremities into long, slender, recurved canals. Inner and outer lips smooth, the latter with a rounded callused edge. Colour pale flesh-pink, labrum white, and the extremities tinged reddish-brown along the dorsal surface.
Length 62.5 mm, maximum width 7.5 mm.

For further reference to this species see Cernohorsky (this volume, p. 126).

Family NATICIDAE

Genus **Notocochlis** Powell, 1933

Type-species (OD) *Notocochlis migratoria* Powell, 1933.

Three fresh but empty shells, found in beach drift at Urupukapuka Island, Bay of Islands, closely resemble the widespread Australian *sagittata,* but present differences in both the form of the funicle, and in the colour pattern.

Notocochlis sagittata hancockae subsp. n. (Fig. 7)

Shell about the same size, general appearance, and coloration as typical *sagittata* but with the following differences:— In the typical subspecies the funicle is short and broadly crescentic, with the bounding groove hemispherical, and the umbilicus widely open, exhibiting its spiral form; also the colour pattern resolves into five spiral zones. In the New Zealand subspecies the funicle is long and narrowly cresentic, bounded by a narrow, shallow groove, that ends above, in a deep, narrow umbilicus, partly hidden by the notched, and bridging, parietal callus. Also the sagittate colour pattern is restricted to three spiral zones of pale reddish-brown crescentic markings, connected by thin lines, into an undulating axial series.

Height 13.5 mm, width 12.0 mm paratype.

Height 11.8 mm, width 11.9 mm holotype.

Height 9.25mm, width 8.25 mm paratype.

The writer is indebted to Mrs M. Hancock of Whangarei, finder of the Urupukapuka shells, both for permission to describe this subspecies, and also for her donation of the holotype to the Auckland Museum.

Family TONNIDAE

Genus **Tonna** Brunnich, 1772

Type-species (monotypy) *Buccinum galea* Linnaeus, 1758

Tonna cumingii (Reeve, 1849)

1849. *Dolium cumingii* Reeve, Conch. Icon. 5: pl. 8, figs. 13b,13c.
1849. *Dolium deshayesii* Reeve, Conch. Icon. 5: pl. 8, fig. 13a.
1904. *Dolium magnificum* Sowerby, Proc. Malac. Soc. Lond. 6: 7, text fig.
1919. *Tonna cumingii*: Hedley, Rec. Aust. Mus. 12 (11): 331.
1931. *Parvitonna perselecta* Iredale, Rec. Aust. Mus. 18: 216, pl. 23, fig. 17.
1938. *Tonna maoria* Powell, Rec. Auckland Inst. Mus. (23): 166, pl. 40, figs. 5,6.
1961. *Tonna chinensis* 'Deshayes' (non Dillwyn, 1817), Rippingale and McMichael, Queensl. and Gt. Barrier Reef Shells: 75, pl. 8, fig. 18.

When the writer described *Tonna maoria* (1938, loc. cit.), on the basis of a single specimen from Houhora Heads, Northland, it was compared with Reeve's *cumingii,* noting that the New Zealand shell had fewer and stronger cords, as well as a different colour pattern. Since then additional material from Northland show

these alleged differences to be untenable, and that such variations are common to similar New South Wales and Queensland shells, that are found in collections under the names of *chinensis* (Dillwyn, 1817), *cumingii* (Reeve, 1849), or *perselecta* Iredale, 1931.

The name *chinensis* (Dillwyn, 1817) was based upon *"Buccinum Australe* seu *Chinense"* in Chemnitz (Conch. Cab. 11: 85, pl. 188, figs. 1804, 1805), but the true identity of that species yet remains to be satisfactorily established. However, reference of *chinensis* to the small *Tonna* in question is negated by the fact that Chemnitz gave the height of his shell as '7 zoll' = 183.12 mm = 7 3/16 inches, a size greatly in excess of the largest *cumingii,* the height range of which is between 67 and 91 mm. Further Chemnitz's figure, as well as his description, indicate that there is an intermediate rib in all interspaces, but in *cumingii,* only occasional intermediate threads occur, and these are confined to the shoulder area.

A Northland specimen from Tokerau Beach, Doubtless Bay, is almost uniformly dark reddish-brown, except for oblong light-buff spots, arranged in distant, flexuous, axial series, and this colour form is identical with one trawled off Tin Can Bay, Queensland.

Height 91 mm, width 66 mm. Tin Can Bay, Queensland.

Height 87 mm, width 63 mm. Bundaberg, Queensland.

Height 68 mm, width 51 mm. Doubtless Bay, Northland.

Height 61 mm, width 50 mm holotype of *maoria.*

The type locality for both *cumingii* and *deshayesii* is Philippine Islands.

Tonna luteostoma (Küster, 1857) (Figs. 8,9)

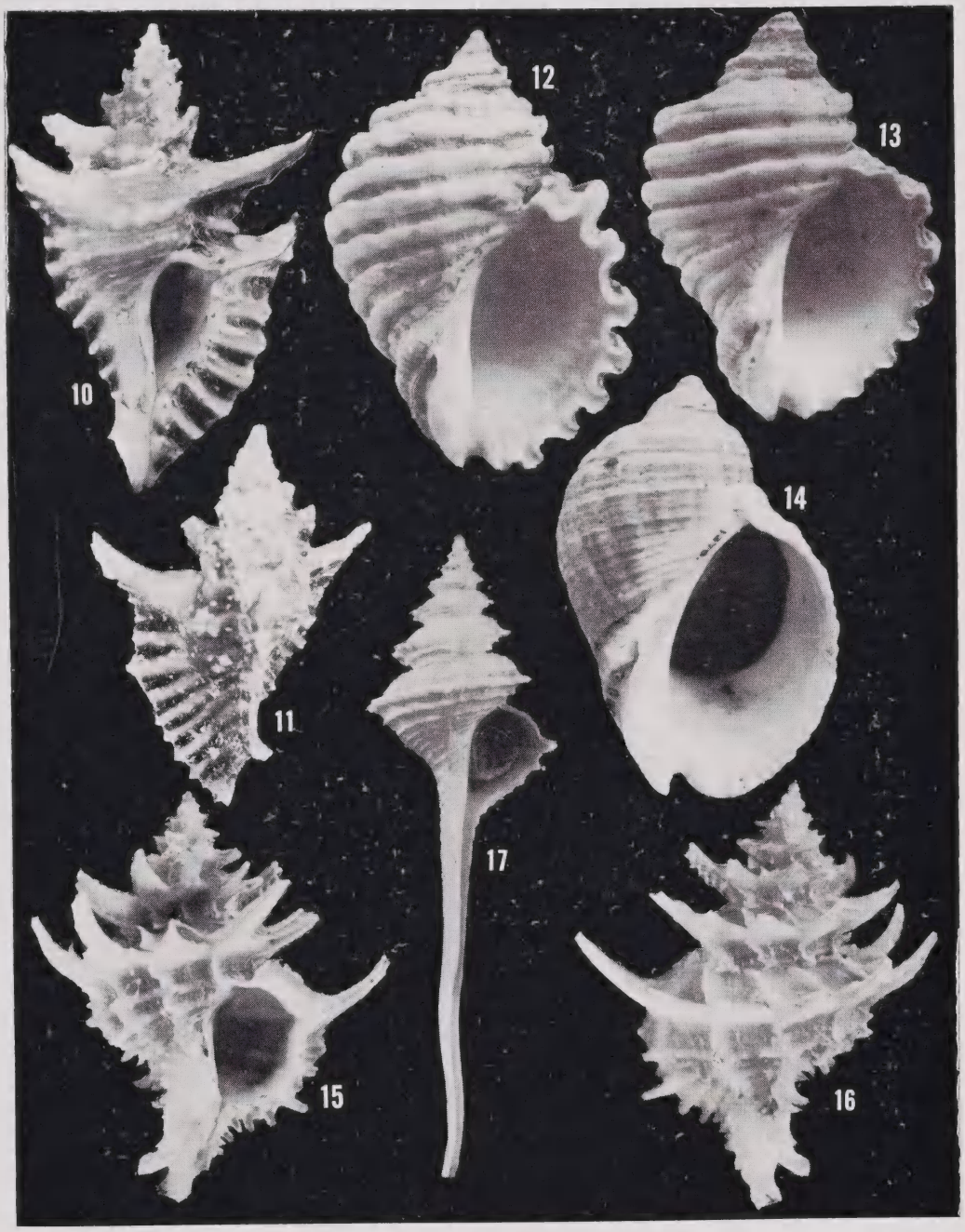
1857. *Dolium luteostomum* Küster, Conch, Cab. 3 :66, pl. 38, fig. 2.
1855. *Dolium luteostomum*: Tryon, Man. Conch. 7 :261, pl. 1, fig. 6.
1954. *Tonna luteostoma*: Kira, Colour, Illst. Shells Jap: pl. 22, fig. 8.

This well known Japanese *Tonna* can now be recorded from New Zealand, on the basis of two beach shells, both in good condition, but not actually taken alive; they were cast up upon a little-frequented sandy beach, just south of Parengarenga Harbour, and found there by the late Mr. A. E. Brookes, probably about 1925.

The shell resembles *cerevisina* Hedley, 1919, but is always of smaller adult size, has a lower spire, bluntly raised shoulder, more deeply channelled suture, and deeper, wider, more square-cut interspaces to the corrugations, and this gives a strongly dentate appearance to the outer-lip, compared with the weak corrugations of *cerevicina.* Also, the uppermost spiral ridges in *luteostoma* are heavier than the rest, and an interstitial riblet is usually present between the first three ridges down from the suture. The colour pattern also, differs in *luteostoma,* in that the reddish-brown maculations are more numerous than in *cerevicina,* and are more evenly distributed.

Height 122.5 mm, width 94.0 mm average sized Japanese example.

Height 98.5 mm, width 84.0 mm. South of Parengarenga, Northland.



Figs. 10-17. 10, 11. *Pterynotus (Pterochelus) zealandicus* (Hutton), off Poor Knights Islands, 9-18m, 31.75 x 19.75mm. 12-14. *Thais orbita* (Gmelin). 12. Shellharbour, New South Wales, 59.0 x 41.0mm. 13. Reotahi, Whangarei Heads, 67.0 x 47.0mm. 14. Motutara, west coast Auckland, 66 0 x 42.0mm. 15, 16. *Latiaxis wormaldi* Powell sp. n. Holotype, Auck. Inst. Mus., 22.75 x 19.75mm, off Poor Knights Islands, 329m. 17. *Columbarium (Coluzea) wormaldi* Powell, sp. n. Holotype, Auck. Inst. Mus., 71.0 x 21.2mm, east of Poor Knights Islands, 549m.

Family MURICIDAE

Genus **Pterynotus** Swainson, 1833

Subgenus **Pterochelus** Jousseaume, 1879

Type-species (OD) *Murex acanthopterus* Lamarck, 1816.

Pterynotus (Pterochelus) zealandicus (Hutton, 1873) (Figs 10, 11)

1873. *Typhis zealandica* Hutton, Cat. Tert. Moll. N.Z.: 2.
1913. *Murex angasi* (non Crosse): Suter, Man. N.Z. Moll.: 404.
1962. *Pterynotus (Pterochelus) zealandicus*: Fleming, Trans. R. Soc. N.Z. Zool. 2(14): 115.

This well known Castelecliffian upper Pleistocene species, the type of which is from the Tainui Shellbed of Wanganui, can now be confirmed as a member of the Recent fauna, on the basis of examples, taken alive, at depths of between 9 and 18 m, off the southern end of the Poor Knights Islands, and also at 6 m off Henry Island, Whangaruru. The specimens were live taken, by Mr W. Palmer of Whangarei.

The shell varies in colour from light brown, with reddish-brown spiral streaks, to bright salmon-pink, with dark reddish-brown patches in the hollows of the axial lamellae. The operculum is yellowish-brown, leaf-shaped, with the sharp terminal nucleus on the inner side, the initial whorl lying at about 45° to the pillar, after which the excentric growth accretions gradually bring the axis to near vertical. The animal is cream coloured, deepening to bright yellow towards the foot. The cephalic tentacles are moderately long, close together at their base, rather sharply pointed, and ledged on the outer side, with a conspicuous black pigmented eye, situated at about one third back from the tip.

Height 31.75 mm, width 19.75 mm.

Genus **Trophon** Montfort, 1810

Type-species (OD) *Murex magellanicus* Gmelin, 1790 = *Buccinum geversianum* Pallas, 1774.

Trophon albolabratus E. A. Smith, 1875

1875. *Trophon albolabrat*us: E. A. Smith, Ann. Mag. Nat. Hist. 16: 68.
1877. *Trophon albolabratus*: E. A. Smith, Phil. Trans. R. Soc., London for 1879 (issued separately, 1877), 168: 170.
1916. *Trophon albolabratus*: Hedley, Aust. Ant. Exped. (c), 4(1) 60.

When *Trophon mawsoni* Powell, 1957 (B.A.N.Z. Ant. Exped. 6(7): 142) was described, it was noted that the species was identical with the shells upon which Tomlin (1948, B.A.N.Z. Ant. Res. Exped. 5: 228) based his Macquarie Island record of *albolabratus*, but it was erroneously assumed that Hedley's 1916 Macquarie Island record also referred to *mawsoni*. Subsequent examination of Hedley's Macquarie Island material which was shore-collected, proved that his specimens are identical with the Kerguelen species, and so *albolabratus* must be reinstated in the Macquarie Island faunal list.

The two species are readily distinguishable; the shallow-water *albolabratus* has rounded whorls, and is sculptured with crisp spiral cords, 5 on the spire-whorls,

and the whole surface is overridden by very numerous axial lamellae, 40-50 on the body-whorl, the points of intersection being imbricated; in the deeper-water *mawsoni*, the whorls are lightly shouldered, and the spiral cords, 4 on the spire-whorls, are overridden by fewer, stronger, and non imbricated lamellae, 20-28 on the body-whorl.

Subfamily THAISINAE

Genus **Thais** Röding, 1798

Type-species (SD Stewart,1927) *T. lena* Röding,1798=*Nerita nodosa* Linnaeus,1758.

(Synonym: *Dicathais* Iredale, 1936. Type (OD) *Buccinum orbita* Gmelin, 1791).

Thais orbita (Gmelin, 1791) (Figs. 12-14)

1784. *Buccinum succinctum* Martyn, Univ. Conch. 2, fig. 45 (not validated by I.C.Z.M. opin. no. 479).

1791. *Buccinum orbita* Gmelin, Syst. Nat. ed. 13: 3490 (based upon Martyn, fig. 45).

1829. *Purpura scalaris* Menke, Verz, Conch. Samml. Malsburg: 34.

1913. *Thais (Stramonita) succincta:* Suter, Man. N.Z. Moll.: 423.

1927. *Thais scalaris:* Finlay, Trans. Proc. N.Z. Inst. 57: 427.

1936. *Dicathais orbita:* Iredale, Rec. Aust. Mus. 19(5): 325.

This is the common rock-shell which, in New Zealand, at different times, has been called either *succincta* or *scalaris*. However, Gmelin (1971) introduced the name *Buccinum orbita* for Martyn's *succincta*, and since the latter was not one of the Martyn names validated by opinion 479 of the International Commission on Zoological Nomenclature, then *orbita* is the name to be used for the New Zealand shell. Martyn, followed by Gmelin, cited New Zealand as type locality for the species, but Iredale (1936,loc.cit.) considered that an error in localization had been made, and that Martyn's figures were of a Sydney shell. The vernacular name for the Sydney shell is "cart-rut shell", referring to a common variation of the species, exactly like Martyn's figures, in that the spiral cords are few and massive, separated by narrow, deeply channelled grooves. However, the "cart-rut" form occurs in New Zealand also, but is rare, the usual form being much smoother, with low cords and intermediate threads, but there is no doubt that both forms are mere extremes in a variable species, that extends from Victoria to New South Wales, Norfolk Island and New Zealand.

Three figures are given, one of the normal New Zealand form (Fig. 14), and two of the "cart-rut" form, one from New South Wales (Fig. 12) and the other from Whangarei Heads, New Zealand (Fig. 13).

Family MAGILIDAE

Genus **Latiaxis** Swainson, 1840

Type-species (monotypy) *Pyrula mawae* Griff. Cuv. = *P. mawae* Gray, 1834.

(Synonym: *Lamellatiaxis* Habe and Kosuge, 1970. Type (OD) *L. (L.) marumai* Habe and Kosuge, 1970).

The species described below is the first member of this warm water Indo-Pacific genus to be found in New Zealand waters. It is named for Mr C. Wormald, who found the type specimen, which he generously donated to the Auckland Museum.

Latiaxis wormaldi sp. n. (Figs. 15, 16)

Shell of moderate size, broadly biconical, with the spire shorter than the aperture plus canal. Sculpture consisting of sharply raised lamellae, coronated at the medial angle into long upcurved hollow spines, and on the base, there are 6 spiral ribs, all of which are scabrous, or weakly spinose, at each lamellose axial intersection. Anterior canal almost closed, and with a fasciolar ridge that bears a spinose series of former canals. Coronate spines and axial lamellae 10 on the last whorl. Colour light pinkish-brown, the spines and lamellae pale buff; interior of aperture pinkish-brown.

Height 22.7 mm, width 19.75 mm.

Locality: E.S.E. of Poor Knights Islands, 329 m.

The species is nearest related to *marumai* Habe and Kosuge, 1970 from the South China Sea; both have the spines as outgrowths from axial lamellae. The New Zealand shell differs from *marumai* in the lack of subsidiary spiral cords between the coronated periphery and the lower suture.

Family COLUMBARIIDAE

Genus **Columbarium** von Martens, 1881

Subgenus **Coluzea** Finlay, 1927*

Type-species (OD) *Fusus spiralis* A. Adams, 1856.

(*Decision pending for suppression of *Coluzea* Allan, 1926; see Bull. zool. Nomencl. 26(1): 42-50).

The New Zealand shells belonging to the taxon *Coluzea* are now considered to be very closely allied to the wider ranging Indo-Pacific genus *Columbarium,* and at most would seem to qualify for subgeneric status only, under that genus. Both taxa have an identical operculum, that is broadly wedge-shaped, tapered, with straight sides, ending in a sharply pointed terminal nucleus; as well as closely similar radulae, consisting of a tricuspid central tooth, and a simple, stout-based curved and sharply pointed lateral on each side. The only obvious difference between the two taxa is in the protoconch, which is paucispiral, smooth and bulbous in *Columbarium,* but flattened on top and carinated in *Coluzea.*

The genus *Columbarium* is Recent in the Indo-Pacific, mostly in deep water, ranging from south east Africa to Japan, Australia and northern New Zealand, as well as fossil in the Maestrichtian and Paleocene of Europe, upper Eocene and upper Miocene of southern Australia, and lower Eocene of the southern United States; the subgenus *Coluzea* has a New Zealand range, which extends from the lower Oligocene to the present, and occurs also in the Eocene and lower Oligocene of Europe, and Recent in South Africa.

Columbarium (Coluzea) wormaldi sp.n. (Fig. 17)

1963. *Coluzea mariae* (non Powell, 1952): Dell, Trans. R. Soc. N.Z., Zool. 3(20) : 211, pl. 1, fig.4.

This species has the broadly conical short spire of *mariae,* but the whorls are shallow, vertically compressed, and with a more prominently flanged peripheral keel, that has fewer and more spinose tubercles. Except for the broad low spire and shallow, vertically compressed whorls, the species resembles *spiralis* rather than *mariae,* so far as the style of sculpture is concerned.

Shell moderately large, with a broad, vertically compressed spire, and a long almost straight canal, that is about two thirds the total height of the shell. Whorls with a flat smooth subsutural area, followed by a convex broader area, bearing 4 weak smooth spiral cords, to the periphery, which is below middle whorl height, and is in the form of a sharply projecting flange, sculptured with regular, broad-based and pointed spines, 12 to 14 per whorl; between the peripheral keel and the lower suture there is a minor keel, that is undulating to subnodose, and on the base there are 5 or 6 narrow but strong spiral cords, that continue from there in diminishing strength over more than half the length of the canal, the remainder of the canal being smooth. Colour white, under a pale olive periostracum. Operculum wedge-shaped as described above.

Height 105.0 mm, width 28.7 mm, spire angle 47°. Off Cuvier Island.

Height 71.0 mm, width 21.2 mm, spire angle 54°. Poor Knights: holotype.

Height 58.5 mm, width 18.0 mm, spire angle 57°. Poor Knights: paratype.

Height 44.0 mm, width 16.0 mm, spire angle 54°. Poor Knights: paratype.

Spire angle variation.

spiralis 34° - 39° : *wormaldi* 47° - 59° : *mariae* 53° - 62°.

Localities: East of Poor Knights Islands, 549 m (holotype); 23 miles (36.8 km) north east of Cuvier Island, 260-270 fm (476-494 m) (Dell, 1963).

Holotype: presented to the Auckland Museum by Mr C. Wormald.

Family BUCCINIDAE

Genus **Cantharus** Röding, 1798

Type-species (SD, Cossmann, 1901) *C. tranquebaricus* Gmelin = *C.* globularis Röding, 1798.

The species described below is almost certainly a *Cantharus,* and this adds a genus as well as a new species to the New Zealand fauna. Unfortunately the material consists of only empty shells, and none has fully mature appertural features, but the style of protoconch, adult sculpture, strong lirations within the outer-lip, and most significantly, the thick densely lamellose periostracum, all point to *Cantharus.*

Cantharus aldermenensis sp.n. (Fig. 22)

Shell of moderate size, ovate-fusiform, with gently rounded whorls; similar in form to a *Buccinulum,* but without the characteristic parietal tubercle of that genus. Proto-

conch bluntly papillate, of 2 smooth globose whorls, the second whorl rather eroded in the best preserved specimen, but evidently ending with a short brephic stage of closely spaced axials, crossed by weaker spirals. Post-nuclear sculpture of numerous broadly rounded axial folds, overridden by broad, rather flattened spiral cords, separated by deep linear grooves; the whole surface covered by a thick densely axially lamellose periostracum. The axials number from 16-20 per whorl, and the spirals 5-6 on the spire whorls. Outer-lip thin, not quite mature in available material, but strongly lirate within the aperture. Parietal callus without a pad or tubercle. Colour dull white under the pale yellowish-brown periostracum.

Height 16.0 mm, width 7.0 mm, holotype.

Locality: East of the Aldermen Islands, 366-475 m, clustered in crevices of a piece of waterlogged wood, but none with the animal.

Holotype: Presented to the Auckland Museum by Mr C. Wormald.

Subfamily PISANIINAE

Genus **Ratifusus** Iredale, 1929

Type-species (OD) *Ratifusus adjunctus* Iredale, 1929.

Ratifusus adjunctus Iredale, 1929 (Fig. 23)

1929. *Ratifusus adjunctus* Iredale, Rec. Aust. Mus. 17(4) : 183.

This is a new record for New Zealand, making the second Recent species of the genus for these waters. The type locality for *adjunctus* is off Montagu Island, New South Wales in 50-60 fathoms (91-110 metres). The species differs from *reticulatus,* the other New Zealand species, in being more slender, with less prominent varices, and the spiral sculpture more in evidence than the axial, which is restricted to weak irregularly disposed growth lines; in consequence, the regular sculptural reticulation, so characteristic of the early spire-whorls in *reticulatus,* is absent in *adjunctus*. The coloration differs also; *reticulatus* is almost uniformly reddish-brown, but *adjunctus* is creamy-white, irregularly blotched with orange-brown, resolving into spiral zones, one below the periphery and the other on the base.

Height 16.0 mm, width 5.0 mm holotype of *adjunctus.*

Height 19.0 mm, width 7.0 mm. Off Poor Knights Islands.

Locality: E.S.E. of the Poor Knights, Islands, 329 m. one example, attached to a piece of waterlogged wood; C. Wormald, May, 1969.

Subfamily BUCCINULINAE

Genus **Penion** Fischer, 1884

Type-species (monotypy) *Siphonalia dilatata* = *Fusus dilatatus* Quoy and Gaimard, 1833.

Penion benthicola delli subsp.n. (Fig. 24)

Shell solid, dull creamy-white, close to *benthicola* but with the whorls weakly angled below middle whorl height, producing a wide steeply descending shoulder slope, and coarser spiral sculpture; 15-16 cords per centimetre on the penultimate whorl,

compared with 20-30 for typical *benthicola;* the axials vary between 15 and 20 for both *benthicola* and *delli.* Also the whorl outlines in *delli* are not so strongly convex, nor are they so deeply excavated at the neck, and the anterior canal is less twisted.

Height 102m, width 38.0 mm holotype of *b.benthicola.*

Height 83.5 mm, width 32.0 mm holotype of *b.delli.*

Height 75.0 mm, width 29.0 mm paratype of *b.delli.*

Locality: E.N.E. of the Poor Knights Islands, 366-475 m.

Holotype: presented to the Auckland Museum by Mr C. Wormald.

All available shells are dead, inhabited by hermit crabs, and have attached to their external surface, numerous calcareous bases, produced by the capulid *Malluvium calcareus* (Suter).

Family MARGINELLIDAE

Genus **Marginella** Lamarck, 1799

Subgenus **Volvarinella** Habe, 1951

Type-species (OD) *Volvarinella makiyamai* Habe, 1951. (= *Longinella* Laseron, 1957; non Gros and Lestage, 1927).

Marginella (Volvarinella) wormaldi sp.n. (Fig. 25)

Shell large for the subgenus, broadly fusiform, smooth and highly polished. Spire with a bluntly rounded apex, and lightly convex whorls, tall, about four-fifths height of the aperture. Body-whorl long, but medially inflated, then gradually contracted to a rounded unnotched anterior end. Aperture rather long but moderately wide. Outer-lip thin edged but slightly rimmed and reflected; evenly arcuate in profile; inner edge smooth, entirely without denticles. Columella with 4 distant plaits, the lower two more oblique than the upper ones. Colour pale olive-buff, except for a white anterior end; the buff area with 3 distinct bright reddish-brown spiral bands of squarish maculations, the middle one weakest, and the uppermost only, visible on the spire whorls.

Height 9.3 mm, width 4.25 mm holotype.

Height 8.7 mm, width 4.00 mm paratype.

Locality: E.N.E. of the Poor Knights Islands, 293-439 m.

Holotype: presented to the Auckland Museum by Mr C. Wormald, who has the paratype in his collection.

Family VOLUTIDAE

Genus **Iredalina** Finlay, 1926

Type-species (OD) *I.mirabilis* Finlay, 1926.

Iredalina mirabilis Finlay, 1926 (Figs. 18-21)

Figs. 18-21. *Iredalina mirabilis* Finlay, off Poor Knights Islands, 439-475m. Figs. 18, 19. ♂, 122+ x 37mm. 20, 21. ♀, 125 x 37mm.

1926. *Iredalina mirabilis:* Finlay, Proc. Malac. Soc. Lond. 17: 59.
1933. *Iredalina finlayi:* King, Trans. Proc. N.Z. Inst. 63(3): 347.
1950. *Iredalina mirabilis:* Powell, Rec. Auckland Inst. Mus. 4 (1): 81.
1951. *Iredalina mirabilis:* Dell, Rec. Canterbury Mus. 6(1): 57.
1954. *Iredalina mirabilis:* Powell, Rec. Auckland Inst. Mus. 4(4): 239.
1954. *Iredalina aurantia:* Powell, Rec. Auckland Inst. Mus. 4(4): p.239.
1956. *Iredalina aurantia:* Dell. Dom. Mus. Bull. 18: 123.
1956. *Iredalina mirabilis:* Dell. Dom. Mus. Bull. 18: 123.
1963. *Iredalina mirabilis:* Dell, Trans. R. Soc. N.Z., Zool. 3(20): 214.
1967. *Iredalina mirabilis:* Beu, Trans. R. Soc. N.Z., Geol. 5(3): 113.

The present writer concurs with both Dell (1963, loc.cit.) and Beu (1967, loc.cit.), in their respective conclusions, that there is only one variable species of *Iredalina,* and that *finlayi,* based upon a lower Pliocene fossil, as well as the Recent *aurantia,* are synonymous with *mirabilis.*

Nevertheless there are some inexplicable factors that are worthy of note. For instance, off the South Island east coast, the more abundant form is the short-spired inflated *aurantia,* and very few of the narrow tall-spired *mirabilis* have been taken in that area, but off the Northland east coast only the slender *mirabilis* form has

been taken. However, the northern *mirabilis* form differs from the typical southern form in having distinct anterior spiral lirations, which are absent from most southern shells, although invariably present in the broader *aurantia* form.

Dell (1956, loc.cit:123) suggested that the two shell shapes could indicate sexual dimorphism, but examination of five living examples recently trawled in 439-475 m off the Poor Knights Islands, all of which were of the slender *mirabilis* shape, showed that three of them were males and two females. The caricelloid apical spine is very well developed in these northern shells, as shown in the figured examples.

Height 140 mm, width 48 mm holotype of *mirabilis*.

Height 109 mm, width 49 mm holotype of *aurantia*.

Height 125 mm, width 37 mm ♀. Off Poor Knights Islands: figs. 20,21.

Height 122 mm, width 37 mm ♂. Off Poor Knights Islands: figs. 18,19.

Family TEREBRIDAE

Genus **Terebra** Bruguière, 1789

Type-species (subsequent monotypy, Lamarck, 1799). *Buccinum subulatum* Linnaeus, 1767.

Terebra circumcincta Deshayes, 1857 (Fig. 26)

1857. *Terebra circumcincta* Deshayes, Journ. de Conchyl. 6:77, pl. 3, fig. 9.
1860. *Terebra circumcincta:* Reeve, Conch. Icon., monog. *Terebra, pl.* 15, sp. 70.
1885. *Terebra circumcincta:* Tryon, Man. Conch. 7:13, pl. 11, figs. 8,9.
1969. *Terebra circumcincta* Cernohorsky, Veliger 11(3): 213.

This record, based upon two living specimens dredged in shallow water at the Bay of Islands, adds a species and a genus to the New Zealand Recent fauna. The type locality for the species was given as 'Red Sea', but the correct location is probably Queensland, since a specimen in the British Museum (Natural History), presumably a syntype, and labelled "Coll.Cuming (ex Stutchbury) Port Curtis, is mounted on a card, along with the holotype. The species has not been recorded from New South Wales, so the New Zealand occurrence shows a considerable southward extension of its range.

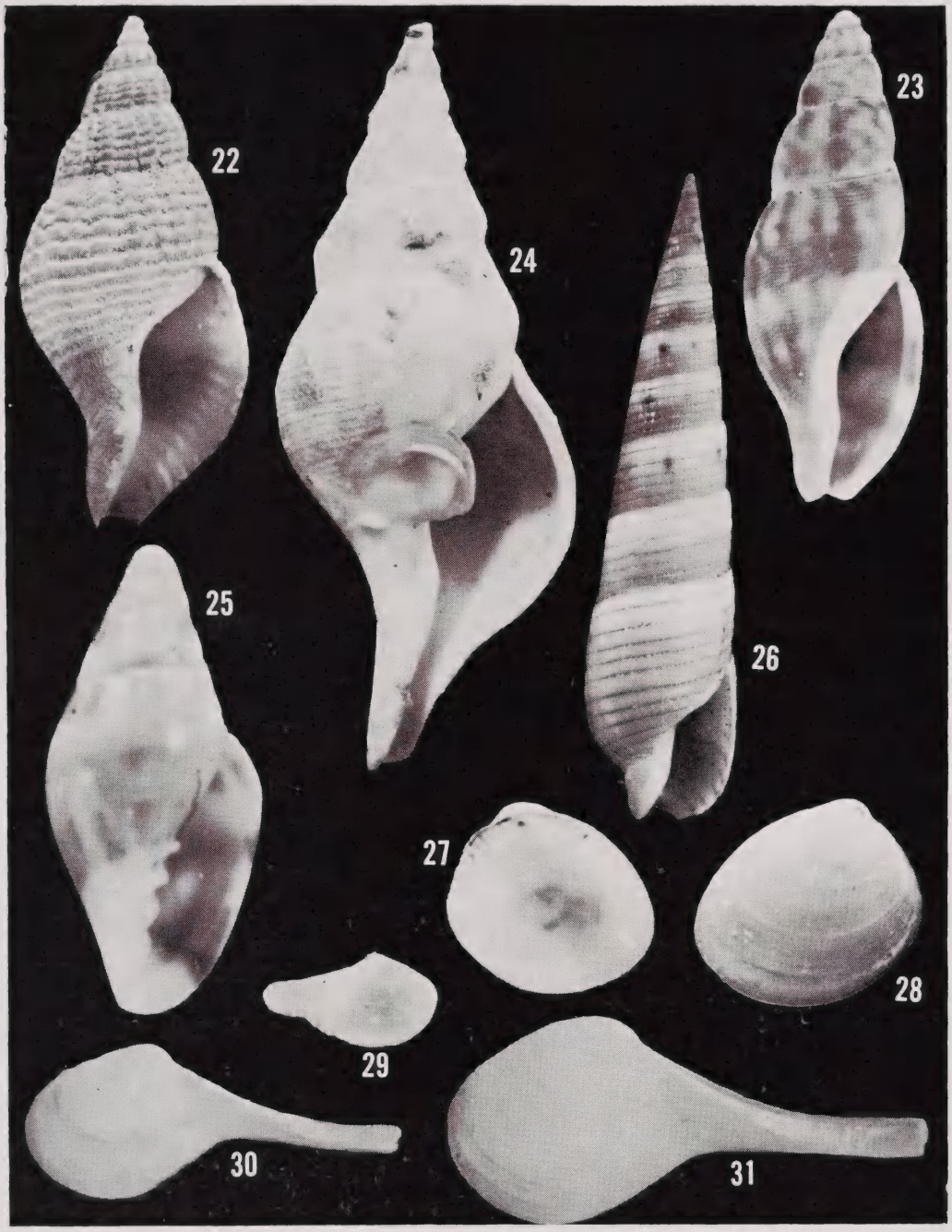
Shell of moderate size, tall and slender, with almost flat-sided spire-whorls. Sculpture consisting of narrow, deeply incised, spiral grooves, which are rendered punctate by bridging growth threads, that are much weaker, to obsolete, on the resultant broad flat cinguli; the spiral grooves number 4-6 on the spire-whorls and 11-12 on the body-whorl and base. Colour of Bay of Islands specimen, ivory, with revolving series of small rusty-brown spots, at the second row of grooves down from the suture.

Height 50.1 mm; width — syntype?

Height 38.0 mm; width 8.0 mm holotype.

Height 31.75 mm; width 7.6 mm. Bay of Islands.

The writer is indebted to Mrs M. Hancock of Whangarei, finder of the Bay of Islands specimens, for the opportunity of examining and photographing the



Figs. 22-31. 22. *Cantharus aldermenensis* Powell, sp. n. Holotype, Auck. Inst. Mus., 16.0 x 7.0mm, east of Aldermen Islands, 366-475m. 23. *Ratifusus adjunctus* Iredale, E.S.E. of Poor Knights Islands, 329m, 19.0 x 7.0mm. 24. *Penion benthicola delli* Powell, subsp. n. Holotype, Auck. Inst. Mus., 83.5 x 32.0mm. E.N.E. of Poor Knights Islands, 366-475m. 25. *Marginella (Volvarinella) wormaldi* Powell, sp. n. Holotype, Auck. Inst. Mus., 9.3 x 4.25mm. E.N.E. of Poor Knights Islands, 293-439m. 26. *Terebra circumcincta* Deshayes, dredged, shallow water, Bay of Islands, 31.75 x 7.6mm. 27, 28. *Nucula nitidulaformis* Powell, sp. n. Holotype, Auck. Inst. Mus., 4.4 x 4.0 - 4.5 x 2.75mm, east of Aldermen Islands, 366-475m. 29-31. *Cuspidaria fairchildi* Suter. 29. Off Mayor Island, 175m, 19.0 x 8.75mm. 30, 31. Off Aldermen Islands, 366-439m. 30. 47.5 x 20.0mm. 31. 67.0 x 27.0mm.

specimen figured, and also to Mr W. O. Cernohorsky for information concerning the type specimens.

Family HYDATINIDAE

Genus **Hydatina** Schumacher, 1817

Type-species (monotypy) *Bulla physis* Linnaeus, 1758.

(Synonym: *Hydatoria* Iredale, 1936, Type (OD) *Bulla cinctoria* Perry, 1811).

Hydatina albocincta (Van der Hoeven, 1839).

1839. *Bulla albocincta* Van der Hoeven, Tijdschr. nat. phys. 6(4) : 245, pl. 10.
1850. *Bulla (Hydatina) albo-cincta :* A. Adams, Thes. Conch. 2 : 566, pl. 120, figs. 17,18.
1893. *Hydatina albocincta :* Tryon, Man. Conch. 15 : 388, pl. 45, figs. 29,30.
1961. *Hydatina cinctoria* (non Perry, 1811) : Rippingale & McMichael, Queensl. and Gt. Barr. Reef Shells ; 151, pl. 21, fig. 2.
1964. *Hydatina albocincta :* Shikama, Select. Shells World Illust. Colours 2 : pl. 1, fig. 13.

A fine specimen of this four-banded *Hydatina*, in fresh condition, complete with periostracum, cast ashore at Tutukaka, Northland, was found by a Whangarei collector in April, 1970.

Diversity of opinion exists among authors concerning the correct name to be used for this well known shell, some preferring *cinctoria* (Perry, 1811) to the more frequently used *albocincta* (Van der Hoeven, 1839). Perry's illustration is badly drawn, and the colour pattern in olive-green and white zones, the latter margined with brown, is unlike anything the writer has seen. The interpretation usually credited to *albocincta*, that of a shell with four wide dark-brown zones on a white ground, is the one here followed, and one that fits the Tutukaka shell exactly. The normal range of the species is Japan to Australia.

Height 52.0 mm, width 46.0 mm. North Australia.

Height: 33.5 mm, width 27.75 mm. North Australia.

Height 32.5 mm., width 26.5 mm. Tutukaka, Northland.

The writer is indebted to Mrs H. Hancock of Whangarei for the opportunity of seeing the Tutukaka shell.

Family NUCULIDAE

Genus **Nucula** Lamarck, 1799

Type-species (monotypy) *Arca nucleus* Linnaeus, 1758.

Nucula nitidulaformis sp.n. (Figs. 27,28)

Shell small, obliquely ovate, inflated, pearly-white under a pale yellowish periostracum. Surface smooth, except for dense extremely fine radial lirations, more distinct over the lower half of the shell. Hinge rather solid, with 8 anterior and 10 posterior teeth, separated by a narrow, spoon-shaped, anteriorly oblique chondrophore. Ventral margin finely crenulated.

Length	height (upright)	height (transverse)	thickness (2 valves)	
4.4 mm	4.0 mm	4.5 mm	2.75 mm	sp.n. *Holotype.*
4.8 mm	4.5 mm	4.9 mm	2.9 mm	sp.n. *Paratype.*
5.0 mm	5.0 mm	5.9 mm	2.0 mm	*nitidula.*
7.8 mm	7.9 mm	8.4 mm	4.0 mm	*nitidula.*

Locality: East of Aldermen Islands, 366-475m.

Holotype and *paratype* presented to the Auckland Museum by Mr C. Wormald.

The species stands nearest to *nitidula* A. Adams, 1856, which differs in being more obliquely elongated, less inflated, without radial sculpture, and with more hinge teeth on the anterior side.

Family CUSPIDARIIDAE

Genus **Cuspidaria** Nardo, 1840

Type-species (monotypy) *Tellina cuspidata* Olivi, 1792.

Cuspidaria fairchildi Suter, 1908 (Figs. 29-31)

1908. *Cuspidaria fairchildi:* Suter, Trans. Proc. N.Z. Inst. 40: 372.
1913. *Cuspidaria fairchildi:* Suter, Man. N.Z. Moll.: 1036.
1956. *Cuspidaria fairchildi:* Dell, Dom. Mus. Bull. 18: 38.
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Dell (1963, loc.cit.) remarked upon the enormous size attained by this species in the archibenthal zone, citing two examples from the Bay of Plenty in 340 fm (622 m), with lengths of from 39 to 40 mm. Even larger examples, from the same area and depth, were obtained by Mr C. Wormald, during the 1969 prawn investigation, the largest having a length of 67 m.

At first sight it would appear that these extra large shells differ from the smaller shells of the shallower waters of the shelf, in having the rostrum equal to the length of the body of the shell, and that the body is decidedly oblique to the alignment of the rostrum. In juvenile examples of only 3 mm in length, the rostrum is barely one third the length of the body, and in intermediate sized shells, comparable with the holotype, the rostrum is half the length of the body, which up to this stage is not oblique to the rostrum. In other words, irrespective of depth, there is a gradual lengthening of the rostrum from one third the length of the body in the juvenile, to a rostrum and shell-body of equal length in the fully adult.

Length 67.0 mm, height 27.0 mm, thickness 20.0 mm. Aldermen Ids., 366-439m.

Length 47.5 mm, height 20.0 mm, thickness 13.7 mm. Aldermen Ids, 366-439 m.

Length 19.0 mm, height 8.75 mm, thickness — Mayor Id. 175 m.

Length 13.0 mm, height 6.0 mm, thickness 4.4 mm. Flat Point, 137 m, holotype.

Localities: South east of Aldermen Islands, 366-439 m (C. Wormald); between Aldermen Islands and Red Mercury Islands, 622 m (R. K. Dell); off Mayor Island, Bay of Plenty, 150-175 m; off Flat Point, North Island, East Coast, 75 fm (137 m) (holotype).

TU'I MALILA, "COOK'S TORTOISE"

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Abstract. Tu'i Malila, the tortoise long kept at the Royal Palace of Tonga, and associated by tradition with Captain James Cook, died in 1966. It has been identified as *Testudo radiata* Shaw, 1802, a Madagascan species, and its possible history is discussed.

In May, 1966, the tortoise long kept and guarded in the grounds of the Royal palace of Nuku'alofa died and was sent to the Museum to be preserved and mounted at the request of the Government of Tonga. According to tradition it was Captain James Cook's gift during his stay in Tonga on the third voyage (in May-July, 1777), and has been described variously in literature as a "giant" tortoise, and presumably by inference since it was thought to be of "giant" size as having originated from one of the Indian Ocean islands inhabited — or formerly inhabited — by large-sized tortoises, or from the Galapagos group, inhabited by a further equally large species.

When received at the Museum the body of Tu'i Malila was partly thawed after transport in deep freeze. The specimen as preserved and mounted by the Preparator, Mr L. J. Cappel is shown in Figs. 1 and 2. Tu'i Malila proved on examination by one of us (J.R.) to be a Madagascan radiated tortoise *Testudo radiata* Shaw, 1802; this species, restricted to Madagascar, is one of a medium-sized group within the genus characterised both by size and by the strongly-arched carapace. Members of the group occur in South Africa, India and Ceylon, as well as on Madagascar. *T. radiata* has well-marked brownish-yellow lines radiating from the centre of each of the shields of the carapace.

The length of Tu'i Malila (carapace: in a straight line) was 41.27 cm (16¼ in.), width 33.00 cm (13 in.), height 24.13 cm (9½ in.). Unfortunately, sex was indeterminable from the reproductive organs, as most soft tissues had almost completely disintegrated, evidently on account of freezing and thawing since death. However, Oliver (1953) states: "In most tortoises the sex of adult individuals is easily ascertained by examination of the . . . . plastron. In male animals the plastron is strongly concave, whereas in females it is flat or slightly convex." A photograph illustrating Oliver's paper shows the markedly concave plastron of a male *Testudo denticulata*. On this basis Tu'i Malila appears to have been a female, though the animal was traditionally believed to be a male (see below). The conformation of the carapace and arrangement of shields is shown in Figs. 3-6.

The characteristic radiate colour pattern is hardly evident, no doubt on account of the animal's extreme old age. The carapace shows sundry dents and scars (see Cameron, 1964, who says: "He is quite blind and carries a much scarred shell, one dent was given him by a kicking horse, another by the wheels of a dray. As he is blind, he had once strayed unseeing into a grass fire in the royal gardens and split his carapace up one side"). These dents and scars are well shown in the accompanying photographs of the mounted specimen.

Rec. Auckland Inst. Mus. 8: 229-233 December 17th 1971

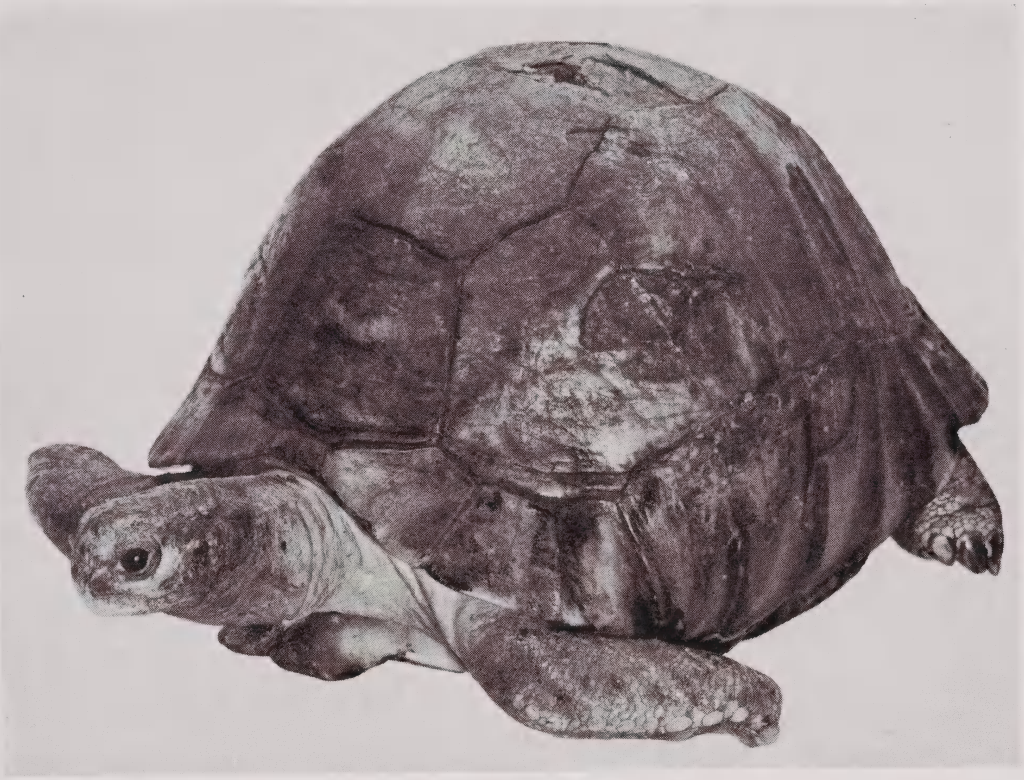


Fig. 1. Tu'i Malila. Front view. (Vahry photo.)

It might be noted in passing that the "giant" tortoises of the Indian Ocean islands (Aldabras, Mascarene Islands, Seychelles), and of the Galapagos, are of very much larger size than tortoises of the medium-sized group including *Testudo radiata*, the shell in large individuals of the "giant" species reaching a length of 121.92 cm (48 in.), or a little more.

The substance of the traditional account of the often-quoted association of Tu'i Malila with Cook is given by Beaglehole (1967 : pp.civ.cv, footnote) : "An ancient and battered animal, he certainly went attended by a Cook tradition. Cook, it is alleged, gave a pair of tortoises to Sioeli Pangia, a chief of Lifuka. When the Tu'i Tonga subsequently visited the Ha'apai group the chief gave them to him as playthings for his daughter at Mu'a. There the female tortoise died a little later; and after the death of the last Tu'i Tonga the male was looked after by the Catholic fathers and sisters at Mu'a. He was given the Tongan name of Tu'i Malila from the place where he lived. He was brought to Nuku'alofa in 1920". Beaglehole (ibid.) goes on to say that in the absence of any written record the tradition connecting the tortoise with Cook must be accepted with reservation, and we are grateful to Dr J. C. Beaglehole for answering in some detail our enquiries on this point and for permission to quote his reply. Dr Beaglehole has confirmed (*in litt.*) that there is no mention anywhere to his knowledge in any of the records of the Third Voyage of the traditionally recorded gift of the tortoises, and adds " . . . it is most unlikely that Cook would have presented any such animal to a Tongan without mentioning the fact in his Journal".

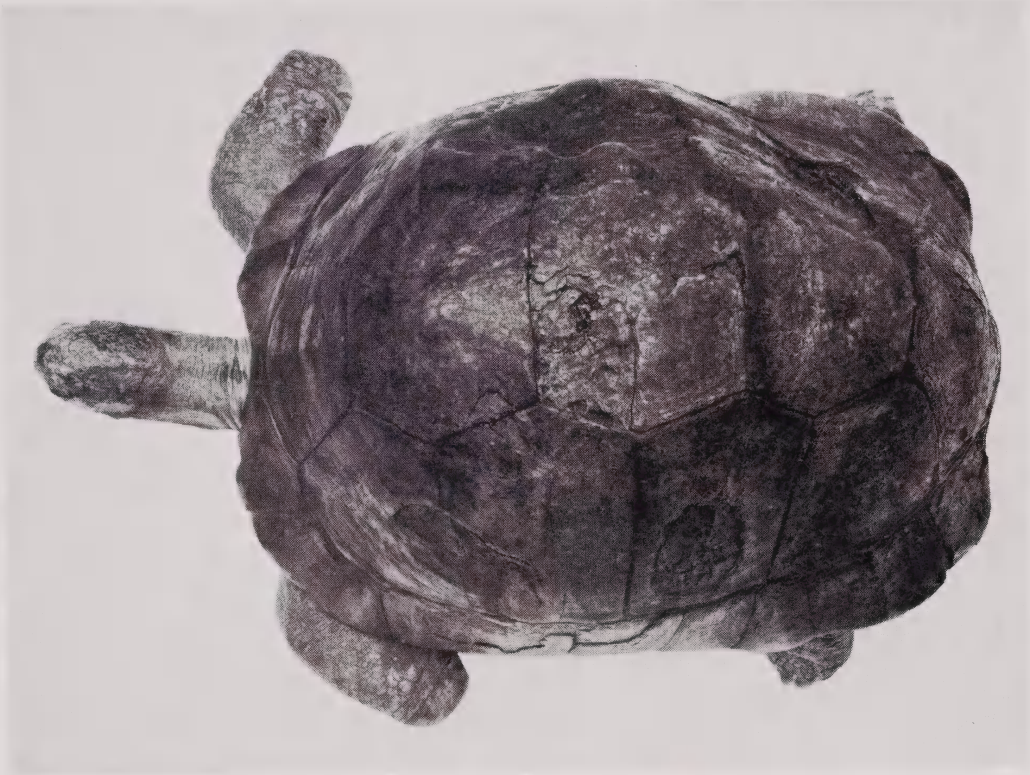
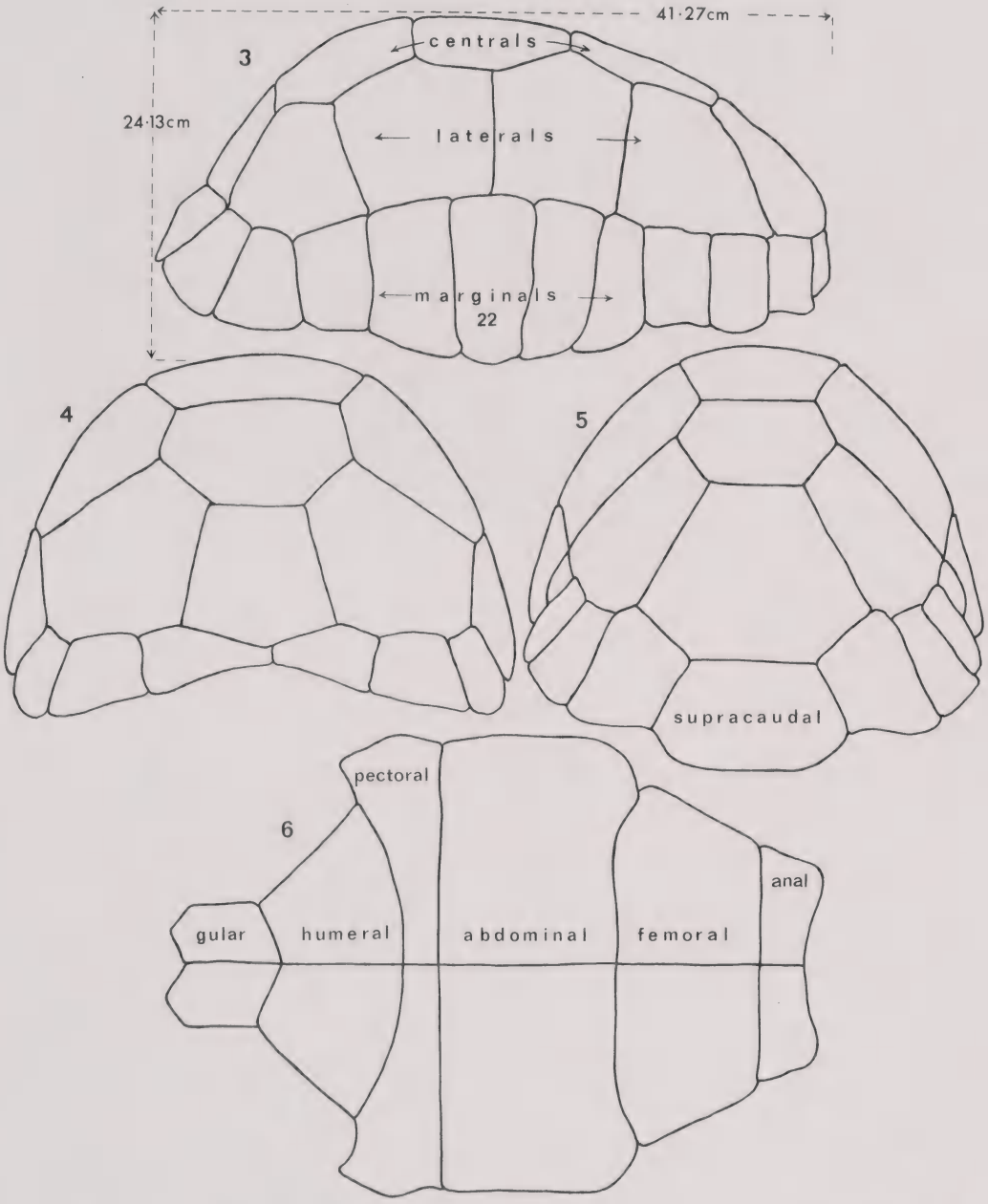


Fig. 2. Tu'i Malila. From above. (Vahry photo.)

Dr Beaglehole has suggested, however, in his letter to us that such a gift could perhaps have come from a member of the ship's company; he says: "Some midshipman could easily have brought one or two on board the ship, as monkeys were brought, for pets, on the second voyage at the Cape Verdes. And just as Cook got fed up with the mess the monkeys caused and had them thrown overboard, he may have got fed up with the tortoises". Or the transaction may have been — again a suggestion from Dr Beaglehole — one of simple trading by the ship's company. In either case tortoises could have been picked up during Cook's stay at Cape Town, and transferred thence to Tonga.

In summary, the association with Cook appears to be a matter of doubt, and must thus remain unless further material on the Voyages is brought to light.

Tortoises — including the "giant" species — were, as described in numerous accounts, frequently carried as food by seafarers of the sixteenth to nineteenth centuries, and as a result several Indian Ocean forms became extinct; whaling gave rise to increased depredations, especially upon the Galapagos species, the stocks on some islands reaching very low ebb. As Loveridge (1946) aptly writes, with reference to the Galapagos: "In those pre-refrigeration days it did not take the whalers long to discover a welcome source of fresh meat in reptiles that could subsist for a long time without food".



Figs. 3-6. *Testudo radiata* Shaw. Nuku'alofa. Carapace and plastron. 3. Lateral. 4. Anterior. 5. Posterior. 6. Ventral (plastron).

Even though possibly not actually associated with Cook's Third Voyage, Tu'i Malila, in view of Tongan tradition, had been in Tonga for a long time, a possible alternative period of arrival being the whaling and trading era of the early nineteenth century.

This still leaves us with a probable age impressive enough, even for a tortoise; authentic records include 100 years in the case of one of the Galapagos giant tortoises, while a Mauritian giant tortoise is known to have survived for 152 years. Referring to longevity in medium and small species Carr (1952) says: "Smaller turtles may require as much time to reach maturity as the most ponderous ones, and their expected life span is not by any means proportionately shorter . . . Nichols estimated that at least 20 years may be required for a New York box turtle to complete its growth, and that the life expectancy is about 40 or 50 years, with good evidence that individuals may attain ages of between 80 and 123 years"; Schmidt and Inger (1957) comment that "the small European tortoises share the capacity for living to a great age for which the giant island forms are especially famous".

The mounted tortoise, returned to the Tongan Government after a period of exhibition in the Museum, is now on show in the International Dateline Hotel at Nuku'alofa.

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FURTHER NEW RECORDS OF FISH IN NEW ZEALAND WATERS

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Abstract. Seven species of fish are recorded for the first time from New Zealand waters.

The species recorded herein have been caught over several years from a wide range of habitats, mostly of deeper waters, by long-lining, scuba diving or trawling. The previously known distributions of these fishes, in South African, Indo-Pacific and Australian waters, suggest they are part of a widespread offshore fauna.

Material for this publication comes from collections in the Auckland and Dominion Museums.

Family GADIDAE

Tripterophycis gilchristi Boulenger (Fig. 1)

Tripterophycis gilchristi Boulenger, 1902, Ann. Mag. nat. Hist. (7) 9: 335-336.

Material examined. E. of Aldermen Is, trawled 200-260 fm (365-475m), 28-31. V. 1969, C. Wormald. Bay of Plenty, 37° 20′ S, 176° 26′ E, trawled 270 fm (493m), Dominion Museum (DM) station 209, 27. II. 1957, DM 2146. N 20 E of Motiti I, 290 fm (530 m), 20. IX. 1962, DM 3503. Off Poor Knights Is, 305-340 fm (557-621 m), 11. XI. 1962, DM 3512. N of Cavalli Is, 350 fm (640 m), 23. XI. 1962, DM 3521. E of Whale Is, 328-400 fm (599-731 m), 30. IX. 1962, DM 3534. NE of Cuvier I, 260-270 fm (475-493 m), 8. XI 1962. DM 3566. N of Cape Brett, 400 fm (731 m), 22. XI. 1962, DM 3570. N of Mayor I, 200 fm (365 m), 28. IX. 1962, DM 3575. Between Aldermen Is and Red Mercury I, 250 fm (459 m), 25. IX. 1962. DM 3587.

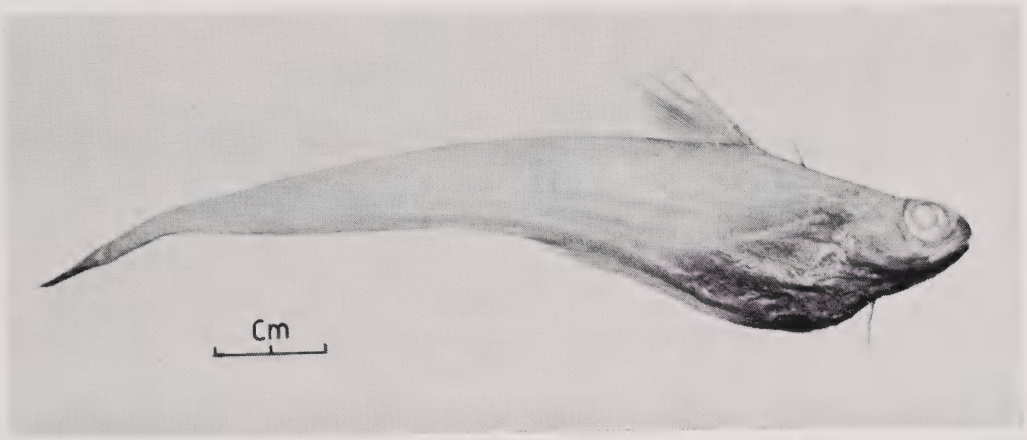

Fig. 1. *Tripterophycis gilchristi* Boulenger. Lateral view.

Depth at anal origin 7.5 - 4.4, head 4.1 - 6.2 in standard length (79 - 193 mm). Eye 3.8 - 2.5, snout 7.6 - 5.6 in head. Interorbital 1.2 - 1.4 in eye. Gill rakers (1 specimen, 176 mm), 10 + 4, narrowly ovate, curve obliquely inward, lightly spiked along inner face especially at base. D iv 13 37, A 105, P 18, V 4.

The deciduate nature of the scales prevents accurate counts of scales and lateral line pores.

Variations, in proportional measurements and fin counts, from the description of Boulenger (1902, p. 335-336) can be associated with body size. I agree with Weber and de Beaufort (1929, p. 11) who regarded these slight discrepancies as falling within the species. There seems little justification, however, in Whitley, (1948a, p. 79) *Tripterophycis intermedius*, a species based on apparently normal variation.

Previous distribution. South Africa, Indo-Pacific and Australia.

Family ZEIDAE

Cyttoidops ventralis (Barnard and Davies)

Cyttus ventralis Barnard and Davies, 1946, Ann. Mag. nat. Hist. (11) 8 : 790-792.

Material examined. E of Aldermen Is, trawled 200-260 fm (365-475 m), 29-31. V. 1969, C. Wormald. Off Kaipara Head, 36° 22′ S, 173° 38′ E, 260 fm (475 m), 20. VII. 1969, "James Cook" DM 4902. Off Coromandel 36° 32′ S, 176° 14′ E, 264-304 fm (482-555 m), "Valkyrie", —. I. 1967, DM 5010.

Greatest depth 1.3 - 1.4 head 2.5 - 2.3 in standard length (240-292 mm). Eye 2.8 - 3.1, snout 1.9 - 1.8 in head. Interorbital 1.5 - 1.8 in eye. Gill rakers (1 specimen, 240 mm), 15 + 1, club shaped, lightly spinose over inner upper border. D ix 35, A ii 36, P 17, V i 6. L. l. 113 + few scales missing, 11 scales from highest point of lateral line to dorsal profile.

This species has been described in three separate publications which appeared in close succession. Priority is held by *Cyttus ventralis* Barnard and Davies (1946) over *Cyttoides jacksoni* Smith (1946, p. 795-796) and *Cyttus mccullochi* Whitley (1948b, p. 148-149).

Previous distribution. South Africa and Australia.

Zenion leptolepis Gilchrist and von Bonde (Fig. 2)

Cyttus leptolepis Gilchrist and von Bonde, 1924, Rep. Fish. mar. biol. Surv. Un. S. Afr. No. 3:17.

Material examined. E of Aldermen Is, trawled 200-260 fm (365-475 m), 8-12. VI. 1969, C. Wormald. 37° 17′ S, 175° 01′ E, Fishing Industry Board (F.I.B.) prawn cruise, R. D. Cooper, DM 5342. 37° 11′ S, 176° 19′ E, F.I.B. prawn cruise, 9.I.1969, R. D. Cooper, DM 5391. 37° 01′ S, 176° 14′ E. F.I.B. prawn cruise, 9.I.1969, R. D. Cooper, DM 5392. NE of Cavalli Is, trawled 260 fm (475 m), Marine Department, 23.XI.1962, DM 5442. N 30° E Poor Knights Is, trawled 256-267 fm (467-488 m), Marine Department, 20.XI.1962, DM 5443. NNE Arid I, trawled 200 fm (365 m), Marine Department, 9.XI.1962, DM 5444.

Greatest depth 2.7, head 2.7 in standard length (1 specimen, 75 mm). Eye 2.8, snout 3.8 in head. Interorbital 1.6 in eye, gill rakers 6 + 12 narrowly triangular, curve obliquely inwards, finely toothed along inner border. D vii 28, A i 31, P 15, V i 6. LL 70 + scales missing.

Fig. 2. *Zenion leptolepis* Gilchrist & von Bonde. Lateral view.

Body proportions of material in Dominion Museum collections not recorded, but specimens range in standard length 39.6 - 74.0 mm.

Previous distribution. South Africa.

Family BERYCIDAE

Actinoberyx longipinnis (Barnard) (Fig. 3)

Beryx longipinnis Barnard, 1925, Ann. Mag. nat. Hist. (9) 15:504.

Material examined. E of Aldermen Is, trawled 200-260 fm (365-475 m), 28-31. V. 1969, C. Wormald. SE of Mayor I, trawled 200 fm (365 m), VII. 1970, pers comm. J. M. Moreland. DM 5237.

Greatest depth, 2.1, head 3.1 in standard length (207 mm). Eye 2.3, snout 4.4 in head. Interorbital 1.9 in eye. Gill rakers 18 + 7, narrowly ovate, finely serrate along inner border. D iv 20, A iv 29, P 15, V i 10. L.l. 60.

Previous distribution. South Africa.

Family EPINEPHELIDAE

Epinephelus damelii (Gunther)

Serranus damelii Gunther, 1876 Ann. Mag. nat. Hist. (4) 18 : 391.

Material examined. Nursery Bay, Poor Knights Is, speared, —. I.1970, R. Grace. Skull Bay, Poor Knights Is, speared 5 fm (9.1 m), 25.II.1970, B. Russell. Doubtless Bay towards

Whangaroa, handline, 25.II.1970, L. Freer. Urupukapuka I, Bay of Is, sub-littoral poisoning 12 ft (3.6 m), II.1961, J. M. Moreland, DM 3149. Urupukapuka I, Bay of Is, II-III.1960, J. M. Moreland, DM 3159. Cape Karekare, speared 10 ft (3.0 m), III.1967, A. Dobbins, DM 4836. Cape Brett, rock crevice 20 ft (6.0 m), 12.IV.1970, B. Crane, DM 5122. Stephenson's I, under rock 20 ft (6.0 m), 8.II.1970, B. Crane, DM 5096.

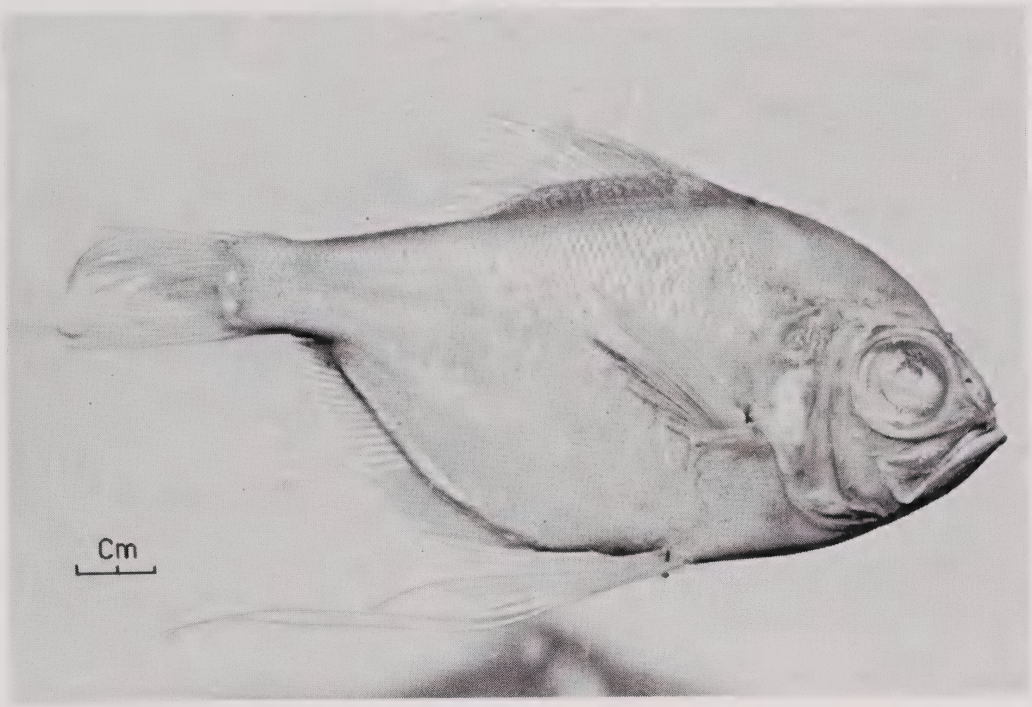

Fig. 3. *Actinoberyx longipinnis* (Barnard). Lateral view.

Greatest depth 3.0 - 3.1, head 2.4 - 2.6 in standard length (337 - 450 mm). Eye 9.2 - 8.1, snout 3.8 - 4.0 in head. Interorbital 0.6 - 0.7 in eye. Gill rakers (2 specimens 410, 450 mm) 16 + 8, 16 + 10, club shaped, bearing spines. D xi 14, A iii 9, P 17, V i 5, L.l. 72 - 73.

Waite (1916, p. 435), while listing affinities in the fish fauna of Lord Howe, Norfolk and Kermadec Islands, indicated the presence of this species in New Zealand waters, but without further comment. Its inclusion in a checklist of New Zealand fishes by Whitley (1968, p. 55) was probably based on Waite (1916).

Previous distribution. Coast of New South Wales, Lord Howe, Norfolk and Kermadec Islands.

Family CHAUNACIDAE

Chaunax penicillatus McCulloch (Fig. 4)

Chaunax penicillatus McCulloch, 1915, Zool. (biol.) Results Fish. Exped. "Endeavour" 3 (3); 167-168, pl. 33, fig. 2.

Material examined. E of Aldermen Is, trawled 200-260 fm (365-475 m), 8-12.VI.1969, C. Wormald.

Head 1.4 in standard length (120 mm). Eye 11.9, snout 8.3 in head. Interorbital, between eye openings on skin, greater than snout, 0.4 in eye. D i 11, A 7, P 13, C 8. Rostral tentacle short, covered with a dense mat of papillae, upper surface and cavity black; features on which McCulloch 1915, p. 167 bases the species. Dermal filaments completely absent.

Previous distribution. Off Victoria and New South Wales, Australia.

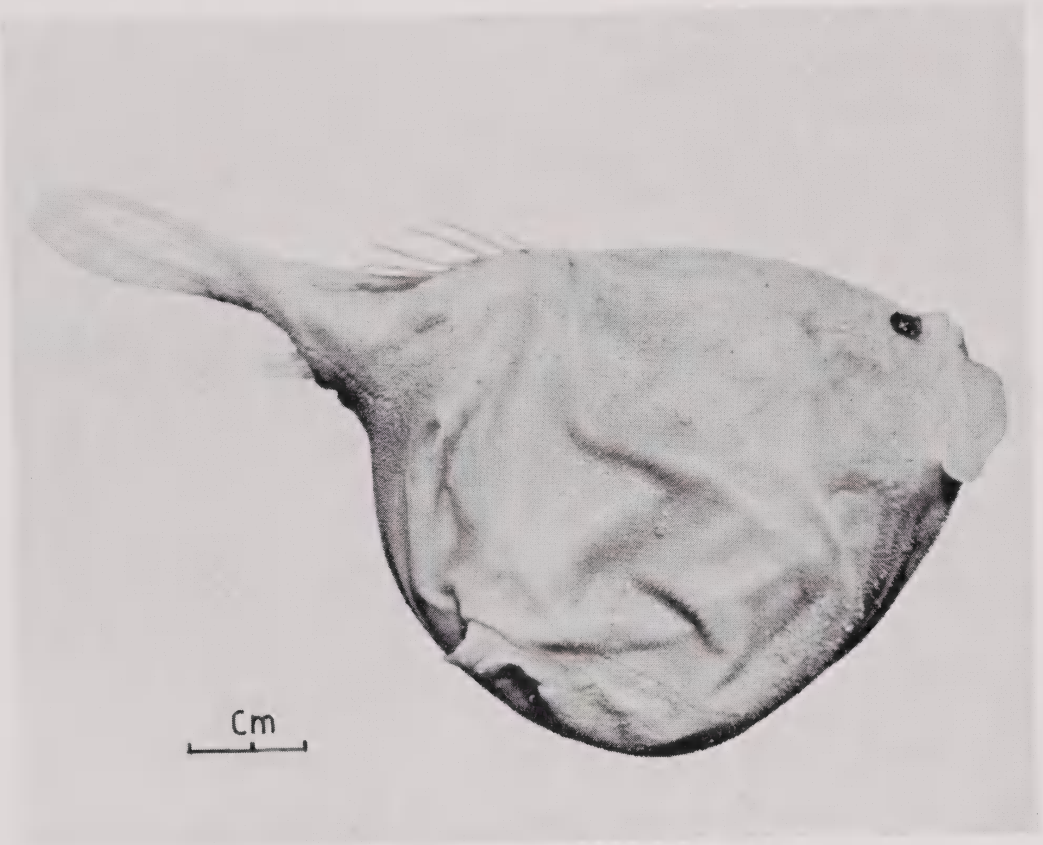

Fig. 4. *Chaunax penicillatus* McCulloch. Lateral view.

Chaunax pictus Lowe

Chaunax pictus Lowe, 1846, Proc. zool. Soc. Lond. 14 : 81-83.

Material examined. 30° 45′ S, 173° 51′ E, trawled 294-370 fm (537-676 m), 6.VII.1962. "Tui" Oceanographic Cruise stn. A.U.Z. 011.02, DM 5525.

Head 1.6 in standard length (89 mm). Eye 8.1, snout 6.6 in head. Interorbital, between eye openings on skin, greater than snout, 0.6 in eye. D i 11, A 7, P 13, C 8. Rostral tentacle club shaped, fimbriated at head, same colour as surrounding skin. Body colour in alcohol pale, but spots on upper surface still discernible.

Previous distribution. From very scattered localities including Madeira (Nth. Atlantic), South Africa, Sea of Japan and South Pacific waters.

Some difficulties have been experienced in determining speciation within this genus, which could be attributed to a saccular morphology and a rarity of specimens. The separation of the species discussed here is entirely reliant on the external nature of the rostral tentacle, but with no regard to its derivation or function. A detailed investigation of this feature could have an important bearing on its usefulness as a species character, and the validity of these species.

Family LAGOCEPHALIDAE

Liosaccus cutaneus (Gunther)

Tetrodon cutaneus Gunther, 1870, Cat. Fish Brit. Mus. 8 : 287.

Material examined. E of Aldermen Is, trawled 200-260 fm (365-475 m), 8-12.VI.1969, C. Wormald. Bay of Plenty, trawled 60 fm (109 m), 14.VII.1956, K. Fraser, DM 2010. Off Cape Karekare trawled 90 fm (164 m), 19.VI.1958, F. Shirley, DM 2598.

Head 2.5 - 2.7 in standard length (166 - 205 mm), snout 2.1 - 2.0, eye 5.0 - 4.7 in head. Interorbital approximately equals snout, 0.5 - 0.45 in eye. Gill rakers (1 specimen 205 mm) 10 + 1, club shaped with papillate outgrowths over head. D 9, A 8, P 15. Skin smooth but covered with fine striations. Lips fleshy and covered with papillae. Anal fin commencing under posterior edge of dorsal.

Whitley (1928, p.238) in discussing the affinities of his *Liosaccus acrobaticus* separated the species on variation in proportional measurements from *L. cutaneus*. A comparison of these measurements (Table 1) and descriptions of *Liosaccus* from the accounts of Gunther (1870, p. 287), Fowler (1920, p. 206), Whitley (1928, p. 237) and from New Zealand material shows sufficient conformity to suggest only one species, *L. cutaneus* by priority.

Table 1. A comparison of measurements recorded for *Liosaccus* sp.

	N.Z. Specimens		St Helena (Gunther)	W. Africa (Fowler)	Australia (Whitley)
Standard length	166	205	—	248	177
Head in SL.	2.5	2.7	—	2.6	2.5
Snout in head	2.1	2.0	rather long	1.8	1.9
Eye in head	3.0	4.7	4.5	4.75	5.0
Eye in snout	2.3	2.2	2.5	2.6	2.6
Eye in interorbital	1.7	2.1	Not much less	1.6	2.5
D	9	9	9	ii,6	i,8
A	8	8	—	ii,6	ii,7
P	14	15	—	i,14	i,15

Previous distribution. St Helena and Azores Islands (Atlantic Ocean), South Africa, and New South Wales.

Acknowledgements. I am grateful for the advice of Mr J. M. Moreland, Dominion Museum, and for his permission to examine and report on material held in their collections. Thanks are also due to Mr C. Wormald who collected material for this Museum during prawn trawls conducted by the Fisheries Industry Board over the 1969 period, and to divers and fishermen who have contributed to these records.

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